EIGHTEENTH YEAR OF PUBLICATION.

MICROSCOPICAL SOCIETY

THE JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.')

Vol. III. (Third Series)
No. LXXXVII.

MARCH
1881.

CONTENTS.

ARTICLES. PAGE

1. The Evolution of the Spheres. By CHARLES MORRIS 121
2. Offensive Manufactures: a Suggestion. By AN OLD TECHNOLOGIST 131
3. On Living Organisms with reference to Polluted Waters. By J. W. SLATER.. 138
4. The Inconceivable as a Test of Truth. By F. H. NASH 145
5. Experiments with the "Jumpers" of Maine. By GEORGE M. BEARD, M.D. 151

ANALYSES OF BOOKS.

Vivisection, its Opponents and Richard Wagner 154

ANALYSES OF BOOKS—*continued.* PAGE

Peruvian Bark 157
The Journal of Speculative Philosophy 159
John Hopkins University, Baltimore 160
The English Universities and John Bunyan 161
Popular Lectures on Scientific Subjects 161
Tables for the Analysis of a Simple Salt 163
History of Plastic Art from the most Ancient Times 164
&c., &c.

CORRESPONDENCE 171
NOTES 177

LONDON:

3, HORSE-SHOE COURT, LUDGATE HILL.

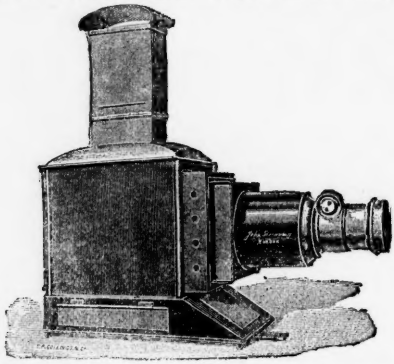
Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

[*The Articles and Reports in this Journal are Copyright.*]

BROWNING'S LANTERNS.

THE NEW THREE-WICK LANTERN.



The new Compact Lantern, with the patent three-wick lamp, for burning paraffin or any mineral oil, will give at least 50 per cent more light than any lamp previously introduced. The lamp burns without a chimney, and the Lantern will give an excellent picture up to 10 ft. diameter.

Price of the Lantern, with three-wick lamp, double combination achromatic front lenses and rack adjustment, complete in case, with condensing lenses 3½ ins. diameter £4 7 6
With condensing lenses 4 ins. in diameter 4 17 6
Pair of the improved Compact Lanterns, with three-wick lamps, for dissolving views, complete in case, with condensing lenses 3½ ins. in diameter 10 15 0
With condensing lenses 4 ins. in diameter 12 10 0

New Illustrated Catalogue of Electric Lanterns, Magic Lanterns, Slides, and Diagrams, Sixpence.

Illustrated List of Instruments, for Presents or School Prizes, at prices from 5s. to £10, sent free.

JOHN BROWNING, 63, STRAND, W.C., LONDON.

South London School of Pharmacy,

325, KENNINGTON ROAD.

MANAGING DIRECTOR—DR. MUTER

Daily Lectures on the following subjects:—

Chemistry.	*Physics.*	*Pharmacy.*
Botany.	*Materia Medica.*	*Classics.*

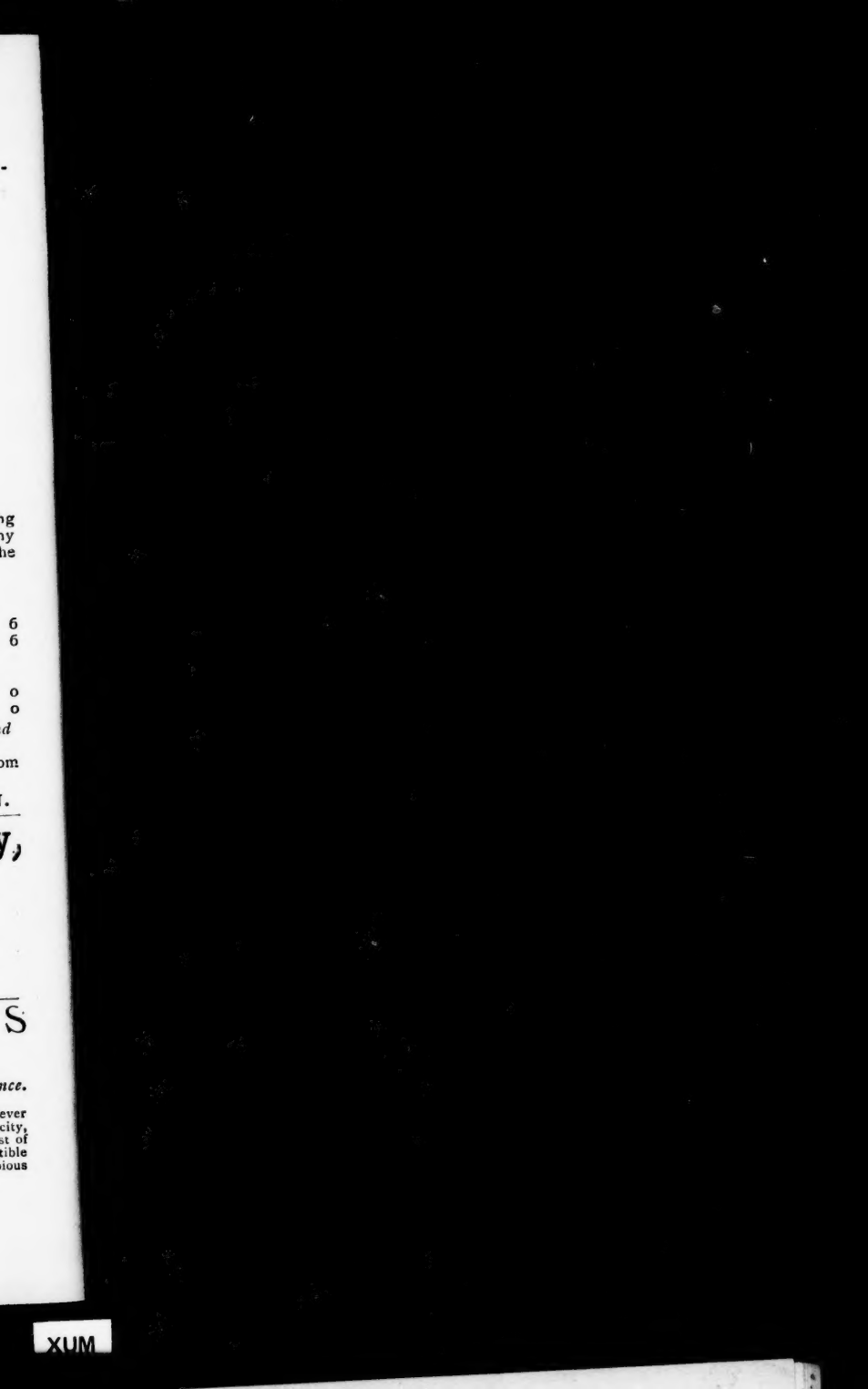
THE CHEMICAL NEWS

Edited by WILLIAM CROOKES, F.R.S., &c.

Published Weekly, price 4d. Annual Subscription, £1, payable in advance.

This Journal is devoted to Scientific and Applied Chemistry, and also embraces whatever tends to elucidate new discoveries in Mineralogy, Metallurgy, Mining, Mechanics, Electricity, and the collateral branches of Physical Science. It also contains an encyclopædic list of chemical papers published abroad during the previous week, with abstracts of all susceptible of advantageous abridgment, thus making the two half-yearly volumes, with their copious indices, equivalent to an English edition of the "Jahresberichte."

LONDON: BOY COURT, LUDGATE HILL, E.C.



XUM

THE

JOURNAL OF SCIENCE.

MARCH, 1881.

I. THE EVOLUTION OF THE SPHERES.

By CHARLES MORRIS.

IN the "Journal of Science" for October, 1880, the writer advanced a hypothesis from which necessarily arise several interesting conclusions. The hypothesis referred to briefly declares that "directive force is an attribute of motion, not of matter; that attraction appears when motions are parallel or convergent; and that repulsion appears when motions are reversely parallel or divergent." The evidences in favour of this hypothesis were given in the article mentioned. I wish now to deduce certain necessary consequences from such a law of force.

All theories of the origin of the existing universe are based on the former existence of matter in a more diffused and disintegrate condition than at present. It is very probable, however, that this diffusion never extended to a state of complete homogeneity. Yet a logical tracing back of the visible steps of the evolution of the cosmical spheres leads to a possible homogeneous and completely disintegrated state of matter as its original condition, and arguments of evolution may be based on such a conceivable primary stage.

If matter then, in the whole, or in any widely extended region of space, once existed in a state of complete diffusion, it becomes a question how the action of force could ever bring it into its present condition of partial condensation. In other words, how could the existing heterogeneous arrangement of matter have arisen from an original homogeneity? The hypothesis which claims that all force is the

XUM

energy of impact of moving matter utterly fails to explain such a change in condition. For in homogeneous matter every moving particle must strike upon and be repelled by an equal number of moving particles in every direction. Its variations in direction must therefore balance each other, and it cannot permanently change its position in space. If every particle thus continue to be confined to a fixed locality there can be no change in the state of diffusion, and the homogeneous state cannot become a heterogeneous one.

Nor could an attractive attribute of matter produce a change in condition in homogeneous matter, since attraction would act equally from all sides, and thus its influence become neutralised. As to attraction and repulsion existing together in such homogeneous matter, the proposition is unthinkable. Only in the above-named hypothesis does there seem to be a ready means of escape from such a condition. If attraction and repulsion be attributes of motion, the one changing to the other as motion reverses its direction, then, in completely homogeneous matter composed of moving particles, these forces should be neutralised, since the divergent and the convergent motions must balance each other, and no excess of gravitative force could exist. But another result would necessarily appear. The attracting motions would tend to approach, the repelling motions to separate But attraction strengthens with approach; repulsion weakens with separation. Therefore a necessary result of the action of these two modes of force must be to immediately give the attractive a more vigorous influence than the repulsive energies.

And from this there springs another result, of equal importance, namely, a sorting out of the attractive and repulsive motions. The former would tend to aggregate, and to drive the latter from their midst. And these latter would be in accord with other motions, towards which they would be attracted. Hence it seems as if there must have arisen minor aggregations of matter, in each such aggregation the similar motions being in excess of the reverse motions. And such aggregations would tend to separate from each other, or to combine into larger aggregations, according as their general directions of motion were similar or dissimilar, and their influence upon each other attractive or repulsive.

Such being a conceivable original mode of integration, it may be possible to show that it is the only mode, and that all the aggregations of matter, up to the present time, have arisen in the manner here indicated, though the essential simplicity of the process is concealed from us by its

diversified forms. The declaration that a mass of moving particles has an excess of motion in one direction is equivalent to saying that the particles move together as a mass in that direction. It is precisely the same result as occurs when the heat-vibrations of molecules become converted into mass motion, through their vibrations having superior vigour in one direction. Such an aggregation of similarly moving particles, therefore, enables the particles to escape from their fixed positions in space. Mass motion arises out of the original individual motions of particles.

This change in the original condition of matter is necessarily a progressive one. The essential advantage which attraction possesses over repulsion must produce a continuous effect. In the original aggregations the similar may have only slightly exceeded the reverse motions. But as the moving particles approached, through this excess of attractive vigour, the increasing energy of attraction must have constantly tended to bring them into more accordant relations. Particularly when these individual attractions converged to form a general centre of attraction would the accordant motions be drawn towards this centre, the discordant repelled from it. Thus in each aggregation there would arise a growing excess of similar directed motions, or, in other words, a growing rapidity of mass motion.

To what extent this aggregation of similar and repulsion of reverse motions would proceed, it is impossible to say; but we can perceive the probability of the assembling of such like aggregations until wide regions of space might be occupied by matter having an excess of motion in one direction, and other wide regions with an excess in the opposite direction. If the attractions and repulsions between particles were originally neutralised through their motions being equal in all directions, the attractions and repulsions of the masses of the universe would still be neutralised by this sorting out of directions of motion, the excess motion of each mass of matter in one direction being balanced by an equal excess motion of another mass in the opposite direction. Instead, then, of there being a universal gravitation, there would be a universal neutrality of directive force—the original neutrality between particles becoming a final neutrality between spheres.

But in each separate mass, considered by itself, attraction would be in excess of repulsion, since the accordant motions would be in excess of the reverse. And the force of this excess attraction must act to produce condensation of the mass, with an increased excess of accordant motions, and a

forcing outward of the reverse motions, the superiority of attraction over repulsion thus constantly augmenting. Thus great waves of matter would begin to move through space, their rapidity of motion increasing as this process continued, every addition to the excess of parallel motions being an addition to the vigour of mass motions.

Such accordance of motion could only arise through a loss of the reverse motions. A particle so related to surrounding forces that it is obliged to move with equal vigour successively in two opposite directions, can gain an excess of motion in one direction only by a loss in the opposing force in that direction, or increased vigour of the opposite force. It must receive this new energy from some impacting substance, or it must in some manner lose a portion of its reverse movement.

This loss cannot well arise through impact. The particles of a sphere strike vigorously in every direction. But their greatest vigour of impact is in the direction of movement of the mass. Therefore loss through impact would tend to bring the mass to rest. But the resistance to impact of ethereal matter is so slight that its effect is inappreciable. Another mode of loss is through radiation. This is an efficient method of loss of the internal energies of spheres, the matter of space freely receiving radiated motion. Yet radiation takes place equally from the whole surface of the mass, and therefore has no effect on its mass motion.

But in every mass, if accordant motions attract and discordant motions repel each other, every movement in harmony with the general direction must be drawn towards the centre, its line of movement gaining a centrifugal curve. Every motion opposite to the general direction must be repelled from the centre, its line of movement gaining a centrifugal curve.* Thus in every mass that possesses an excess of motion in one direction, and therefore an excess of attraction over repulsion, all accordant motions must converge towards, all discordant motions diverge from, the centre. This sorting-out process incessantly continues, the reverse movements slowly travelling outwards, the parallel motions travelling inwards. Condensation of the mass is a necessary consequence, and also its movement as a whole,

* One consequence of this is that the impact energy of accordant motions must have a slight excess in the direction of the centre, that of discordant motions must be in excess outwardly. Every stroke of an attracted particle is partly directed inwards by gravitation; every stroke of a repelled particle is partly directed outwards. However slight this may be, it is a continuous effect, and must give the accordant energies a constant centripetal advantage over the discordant.

for the motions of its particles in one direction are all retained, while those in the opposite direction are gradually lost. This process must be most efficacious at the centre, its vigour decreasing outwardly. It may be, then, that at the centres of many of the spheres all reverse motion has been lost, and only the mass motion retained. In such a case an absolute zero of temperature would exist at the centre. At the surface of the spheres the greatest quantity of reverse motion would exist, the atmosphere being its final recipient in its outward flow, and also yielding it less rapidly from the decrease in repulsive energy.

In this way the motions of the great bodies of space may have originated. Minor aggregations of accordant motions combined into great aggregations. Masses discordant in motion repelled each other, leaving a region of disintegrated matter between them. Motion of these masses through space increased in rapidity as reverse motion was repelled. As motions became more and more parallel, condensation increased. This, again, caused a rapid increase in the vigour of attractive energy, and also a more vigorous repulsion of the reverse motions, so that at once there arose a greater rapidity of mass motion, a more vigorous gravitation, and a more rapid reduction of temperature.

The mass as yet, however, would be cylindrical, not globular. Its attractions would converge to an axis, with only a somewhat stronger vigour at the central point of this axis. There would, however, be a growing excess of vigour of the centre over the axis as the mass became more condensed. And as minor aggregations into atoms and molecules arose in the mass, the attractive vigour of the internal motions of these would converge to the centre. In consequence the central must constantly grow in vigour over the axial attraction, and the cylinder change more and more into the globular figure. And now the inward curve of accordant motions would be directed towards the centre, with a tendency to rotate around it. But such motions might balance each other in every accordant direction, so that the tendency to rotate in any direction around the centre would be opposed by the opposite tendency. Yet, although the temperature motions in the mass as a whole might be balanced in direction, it is quite probable that they would not be homogeneous in distribution, and that positive movements might arise, to be balanced elsewhere by reverse positive movements. Such a wind of positive motion arising near the centre, in the region of strongest attraction, would have a more vigorous preservative influence than more

distant movements. Its tendency to rotate around the centre would therefore have an excess of vigour over the opposite tendency of more distant movements, less influenced by gravity. Thus a positive motion of rotation would ensue. And from this would at once arise a new excess of attractive energy, all motions parallel to the rotation being drawn inwards, all reverse motions driven outwards, until finally the central rotation communicated itself to the whole mass. And as this vigour of rotation increased, through repulsion of the opposite motions, the movement of the mass through space would slowly cease to gain new vigour, the secondary process of evolution finally quite taking the place of the primary. But the principle involved does not stop here. The production of accordant directions of motion still goes on. Only in the gaseous portions of the earth's material does the energy in excess of that employed in cosmical movements yield irregular motion. Partly in the liquid, and largely in the solid form of matter, this irregularity has been reduced to regularity. The impacting motions, which in the gas move in every direction, in the solid are constrained in direction, the particles, so far as this increment of their motion is concerned, being confined to a fixed locality; and their motions within this limited space are probably in the line of direction of the cosmical motions, since they do not result from impact, except in a minor degree, and are thus free to conform to the attractive influences exerted upon them from without. Other results of the principle of motion which we have here considered appear in the movements of matter in atomic and molecular aggregation. But a consideration of these must be left for a future article.

There are, however, certain cosmical consequences of the hypothesis yet to be considered. It might, for instance, be supposed that in the vast regions of space between the condensed spheres the aggregating principle here advocated would reappear, and new condensations of matter arise. Nor is it impossible that minor aggregations of this kind have arisen: but large aggregations are very unlikely to appear. For the material occupying this space is the receptacle of the vast volumes of moving energy lost as temperature to the condensing spheres. This must act to increase the motive vigour and the diffusion of the matter of space (it expanding to fill the void left by the contracting matter of the spheres), and to reduce the vigour of attraction between its separate particles. Moreover, the motive energy thus poured out from the spheres comes from sources of diverse motions, so that every tendency to produce accordant

motions in the matter of space may be negatived by the reverse motions yielded by the spheres. Thus the force yielding action of the spheres exerts a double influence adverse to the formation of new aggregations of the matter of space.

As to the dimensions of the original aggregations of matter it is impossible to decide. The solar system may be the result of a single nebular aggregation, or it may be a portion of a much greater astral aggregation. Its great separation in space from other solar systems is an argument in favour of the former; and, as we have seen, its motion as a whole through space is no necessary proof of its gravitative connection with other solar systems.

In fact the arguments here given tend to show that gravitation is local, not universal, and that, between the spheres of the whole of space, the repulsive just equal the attractive energies. From this possibility a somewhat striking deduction arises. If our solar system has its free motion through space as a result of its mode of aggregation, and not from original connection with the surrounding systems, it is probable that the general direction of internal motion in each of these systems may differ to some extent from that in the solar system, and that while some may be attractive, others may be repulsive in their influences.

But the motion of our system is as likely to be towards a repelling as an attracting system. We may, therefore, safely question what would happen in the former case. Suppose two such systems to approach each other at the vast speed with which solar systems move through space. Whether moving directly together or not, their repelling energies would act with a rapidly increasing vigour as they came nearer together. And this repulsion must necessarily lessen their rapidity of motion, and might, in extreme cases, bring them to a dead halt. What would result? Their lost motion of translation through space must fall back into their mass, and become heat vibration of their particles, the reversal of motion in one sphere being just balanced by the reversal of motion in the other. As their motion decreased, therefore, their temperature would increase, and this result, in extreme cases, might be sufficient to dissipate the two systems into their original vaporous state. In this hypothesis, then, we perceive one possible mode of disintegration of the spheres, an action which may eventually influence every solar system of the universe, and thus cause an infinitely repeated process of integration and disintegration of spheral masses, instead of a single irreversible process of

evolution from original ether to motionless and dead worlds.

In the case of two attracting systems approaching there would necessarily be a rapid augmentation of the motion of each. But this new motion could only be gained at the expense of the internal temperature of the spheres (as argued in my article on Heat Transformations, in the "Journal of Science" for June, 1880). Thus in two such systems there would be a rapid diminution of temperature, accompanied perhaps by an extreme condensation. But if they should come into contact with each other a result would arise similar to that shown above in the case of two repelling spheres. Their sudden loss of mass motion would yield a sudden increase of heat motion, and disintegration might also, in this case, occur. Thus the hypothesis that force is an attribute of motion yields us the possibility of an infinitely active universe, instead of a finite one, as under the hypothesis that force is an attribute of matter.

Before concluding, however, a certain degree of recapitulation seems desirable. We have argued that in the conceivable original homogeneous diffusion of matter there was an equal balance in the directions of motion, every movement in one direction being somewhere balanced by a movement of equal vigour in the opposite direction. But however heterogeneous the state of matter in the universe, this condition continues necessary. For if, taking the universe as a whole, its sum of motive energy in one general direction should exceed its sum of motive energy in the opposite general direction, the universe must move for ever in that direction, there being no force in existence capable of reversing this excess of energy. Or, if we could imagine the existence of space beyond the material universe, then a section of matter containing this excess motion might separate from the remaining matter, and move eternally onward, leaving the other section of matter in eternal rest. Such a condition of affairs seems inconceivable. But if there is not this eternal movement in one direction of the whole or a portion of the universe, then there must be a balance of its motive energies in every opposite direction. Such a balance, once existing, must be eternal. The universe, once at rest in infinite space, could never begin, of itself, to move through space.

Yet the continued existence of such a balance requires that no particle can gain a movement in any special direction unless some other particle gains an equal opposite movement. And such an exchange always occurs, whatever

the acting force, whether impact, attraction, or repulsion, In every case of impact there is always an equal exchange of momentum. Where the motions of the impacting bodies are reversed, the new paths assumed exactly replace the old paths lost. Where they move together after contact the new path is the exact equivalent of the two former paths. The heavier body necessarily suffers the least change in direction, otherwise the balance would be destroyed.

It is the same with attraction. Attractions are always equal and opposite. Any body moved by attraction causes by its opposite attraction an equal reverse momentum in the acting substance. In repulsion it is the same; both bodies are driven equally from the original path.

If a small mass approach the earth its speed may become extreme, there being an apparent loss of motion in one direction or gain in the other. But the earth moves towards the falling body with equal momentum. Thus the gain of momentum in one direction by the body is precisely equalled by a reverse gain of momentum by the earth, and the great balance of force remains undisturbed. This principle, in fact, cannot be overthrown by any conceivable action of force. The universe is a vast pendulum, where every forward swing of a particle is balanced by a simultaneous backward swing of some other particle, moving with equal vigour.

Necessarily, then, the positive motions now possessed by spheres must be balanced by equal opposite motions possessed by other spheres, or else by an equal excess of motion in the opposite direction possessed by the matter of space. It is into this matter of space that the moving spheres have discharged their reverse motions. The particles of these spheres have thus lost a considerable portion of their original motive energy, yet they retain a large percentage of it. They have lost a part of their motive energy in one direction, and move constantly forward in the opposite direction with a rapidity equal to the rapidity of the lost reverse motion. This may enable us to gain a more definite idea of the rapidity of the original motion. Every particle of the solar system moves through space at a speed of about 250 miles per minute. Every particle of the earth moves around the sun at a speed of 1100 miles per minute. Every particle of the earth's equator moves around the centre at a speed of 17 miles per minute. Yet these excessive speeds only indicate the speed of motion lost in the opposite directions. In addition to this a considerable vigour of reverse motion is still retained, giving every particle rapid individual

movements of vibration. Besides all this energy of molecules as wholes, every molecule or atom is a mass of minuter elements, which very probably possess a rapid centripetal moving energy. The matter of space, therefore, if reduced to a condition of complete disintegration, would possess individual movements of almost inconceivable rapidity. A large percentage of this original motion still exists in spheres, though it is curbed and controlled in direction by the various specializations to which it is subject, and is very largely centralized by centripetal energy, and thus fails to make itself outwardly apparent.

That the matter of space was ever completely disintegrated seems impossible, from the above considerations. More likely there has been incessant integration and disintegration through the influences here specified, so that the existing condition of the universe indicates its eternal condition.

The argument here advanced may lead some readers to the idea of possible future catastrophes. It may be imagined that our premises require sudden changes from a condensed to a nebulous condition in the spheres. Yet no such necessity exists. If the motion of our solar system were directed towards its nearest neighbour in space it would need one million years to reach it, at the present rate of speed. It is really directed towards orbs which it must take many millions of years to reach. If now the influence of these orbs were repulsive, there would be an exceedingly gradual diminution of the motion of our system, and as gradual an augmentation of its heat. Yet this augmentation, being internal as well as external, could not radiate, as fast as produced, into space, and must therefore greatly increase the heat energies of the sun and planets, even if insufficient to reduce them to their original gaseous state.

In the contrary case, of two attractive systems approaching, it is almost infinitely improbable that they would move directly towards each other: therefore they would be very unlikely to come into actual collision, but would curve around each other as a comet curves around the sun. The internal refrigeration caused by their great enhancement of speed in approaching would be succeeded by a regaining of their lost temperature, through decrease of speed in separating.

Thus the idea that the existing mode of evolution in the solar system must be continuous, and lead to a final loss of all the active energy of the spheres, is based on a view that embraces our system only, and leaves out of sight its

neighbours in space. It really has a source of new energy in its motion through space which may, as we have seen, be made available through the attractive or repulsive action of other systems, its process of evolution at one period of time being reversed at another period.

Again, in the case of two repelling spheres bringing each other to rest, with the conversion of their mass motion into heat, a portion of this heat is radiated into space. Therefore on their subsequent separation by repulsion, a part of their former energy of mass motion has been lost, and must be replaced from their original store of heat. Here, then, seems a source of a gradual and irreversible loss of heat into space, which must, after some interminable period, exhaust the available energy of the spheres and limit their activity.

But this loss may be met by a gain in an opposite direction. Attractive spheres will be met as often as repulsive. These, by the excessive increase of speed, may become greatly refrigerated, and receive radiant heat from space instead of radiating into space. Thus the loss of energy in the one case may be balanced by a gain of energy in the other. And finally there may be regions of space of a temperature sufficient to prevent or to reverse the radiations of the spheres.

It seems, then, as if the universe may be organised on a self-regulating principle, all its changes being paralleled by counter-changes, its losses replaced by gains, so that the condition it now displays is a counterpart of the condition it has maintained throughout the eternity of the past, and will maintain throughout the eternity of the future.

II. OFFENSIVE MANUFACTURES: A SUGGESTION.

By An Old Technologist.

MUCH has been already done in the way of rendering certain manufacturing and mining operations less noisome to the general public than was formerly the case. The production of black smoke beyond certain limits is interdicted,—at least if the local authorities choose

to put existing laws in force. The "Alkali Act" has, to a very considerable extent, checked the free emission of acid vapours, and it is probable that further and more comprehensive legislation in the same direction may soon follow. As regards the water-courses, the Rivers' Pollution Act is gradually working an amendment in their condition, which will soon grow apparent if its provisions are not suffered to become a dead letter. In addition to all this, any person who feels himself aggrieved by the refuse of industrial operations sent up into the air, or allowed to drain into the rivers, may, if his means permit, apply for redress to the High Court of Chancery, and, if he can show that definite injury is being done either to his health or to his property, an injunction for the abatement of the nuisance will be issued.

Still all these various remedies leave very much of the evil untouched. Certain kinds of manufactures have been placed under restrictions and inspection, more or less complete and efficient. Other kinds, not less offensive in their results, have not been interfered with. Where the iron trade flourishes vegetation is blighted, the air is polluted, and the light of day blotted out quite as much as in a region of alkali works. The consumption of smoke is not demanded from blast-furnaces, and the quantity of the oxides of sulphur which they pour into the air is simply enormous. Let us take an establishment of this kind which burns 200 tons of coal daily, by no means the maximum consumption. If such coal only contains 1 lb. sulphur per ton,—which is far below the average in Lancashire, Staffordshire, and Warwickshire,—there is given off daily sulphurous anhydride equivalent to 600 lbs. of oil of vitriol, or, taking a year of 300 working days, 180,000 lbs.! As a matter of course all vegetation exposed to acid vapours and acid rain is destroyed. Not the less certain is it that every portion of buildings capable of being affected by acids is corroded. Were such damage wrought by chemical works, complaints would multiply, and legal proceedings would soon be taken. But it seems that the sins of an iron-smelter are more leniently dealt with than those of a chemical manufacturer.

Looking at such facts, and many others of a like kind which might be brought forward, it seems to me very doubtful whether any measure applied in an indiscriminating manner to the whole country can ever meet the just demands of all parties concerned.

We are placed in a dilemma. On the one hand, in a narrow island like Britain, with a cold, weeping, and

precarious climate, manufactures and mining are a necessity for the support of the present population. We must therefore be very cautious how we impose upon manufacturers burdens and restrictions which may render them unable to compete with their foreign rivals. Indeed, what with limitations on the hours of work and with sanitary and philanthropic regulations of various kinds, we have, in the opinion of many persons well able to judge, gone quite far enough, unless our neighbours would follow our example. Hence we can scarcely impose additional restrictions upon the nuisances and eyesores apparently inseparable from the industrial arts. Inseparable, I say, so long at least as coal is the great source of heat and of mechanical power. Could we do away with coal-dust, coal-ashes, coal-smoke, and coal-mines with their hideous "spoil-banks," and obtain motive energy from the rise and fall of the tides, we might take heart.

But, on the other hand, the farmer and gardener have good reason to complain of the destruction of their crops, no small part of the soil of Britain being for food-producing purposes rendered non-existent. All sorts and conditions of men are warranted in protesting against the acidification of the air, the over-clouding of the sky, the soiling of their houses, their clothing, and their persons, and the general making everything—natural or artificial—loathsome and hideous to their senses. How are we to reconcile these two contending necessities?

The way out of this dilemma may be found by a reference to domestic life. In every household there are processes and products, the refuse of cooking, of washing, and of human life itself, which are more or less noisome and unsightly. We cannot dispense with these processes; we cannot prevent the continued formation of such refuse. But we can and do act upon the old principle of a place for everything, and everything in its place. We do not allow the slop-pail or the suds from the washing-tub to stand in a corner of the drawing-room, no matter under what cleverly devised rules and regulations. We do not suffer fish-bones and oyster-shells and the parings of vegetables to be deposited in our libraries or in our consulting-rooms. Nay, what is the circumstance which we most regret in the condition of the poorest classes of our great cities? Is it not that want of space compels them to cook, and wash, and eat, and sleep in one room? Surely the moral of these considerations is plain to be seen. We do, as a nation, what no person in comfortable circumstances does in his house, and what we

see with such pity in the dwellings of the poor—we mix all up together. Custom has rendered this process so familiar to us that many persons cannot even conceive the possibility of allotting out different parts of a country for different purposes, and of having for such parts entirely distinct laws and regulations. Yet that such an arrangement would be for the benefit both of manufacturers and of the rest of the community can be shown beyond the reach of doubt. The manufacturer, within his appointed districts, might enjoy very considerable latitude as regards the escape of fumes, the discharge of polluted waters, or the accumulation of alkali-waste, chrome-waste, spent shales, slags, &c., so long as he occasioned no demonstrable injury to public health. The farmer, on the other hand, in his districts, might plant and sow without the fear of his crops being blighted by corrosive vapours. The country gentleman would not be annoyed by the withering of his woods and plantations, and every man's tastes would be gratified.

It is to be remarked that a certain rough sorting-out of trades and manufactures was effected by nature. The iron-foundry, the cotton- or woollen-mill, the alkali-works, &c., were, from obvious reasons, erected where fuel is cheap,—in other words, on or near to the coal-mining regions. By a fortunate coincidence these districts are generally of little value from an agricultural point of view, and until the rise of manufactures they were very poor and scantily peopled. As little are they noted for beautiful scenery. It would perhaps be difficult to find a tract of country less favoured by nature than South Lancashire; and if its eastern section has become the centre of the cotton-trade, and its western part the head-quarters of some of the largest chemical manufactures in the world, there is an admirable fitness in the localisation. It seems scarcely fair that great land-owners, whose barren and unprofitable acres have been covered with manufacturing towns and villages, should complain of the nuisances incidental to the very trades which have so largely magnified their rent-rolls. They cannot, by any Royal Commission or Act of Parliament whatever, succeed in both keeping their cake and eating it. If they will preserve their fields and trees green, as was the case two centuries ago,—if they aspire to catch trout in the Sankey Brook,—they must be content with the slender rents which fell to the share of their ancestors.

But the natural division which sprang up between manufacturing and agricultural-residential districts is now less well-marked than was the case fifty, or even twenty, years

ago. The greatly improved means of communication have to some extent levelled the cost of fuel over many parts of the kingdom, and have rendered it possible to establish manufactures and to introduce nuisances where it would once have been simply impracticable. If caprice should induce anyone to erect alkali-works in the Isle of Wight, or on the banks of Derwentwater, there is nothing to prevent him, and the laws concerning nuisances—gaseous, liquid, or solid—would not press more severely upon him than at St. Helens or Widnes. There is no authority to say to him "So long as there is abundance of available land where there is nothing to spoil, you shall not come to any place characterised by its beauty or its fertility;" or, returning to the illustration we used above, to bid him put his refuse in the dust-bin, and not in the drawing-room.

The honour of first distinctly enunciating the principle that sanitary laws must be modified according to the existing character of the district belongs unquestionably to Mr. W. Crookes, F.R.S. When giving evidence on the Rivers' Pollution question, before a Committee of the House of Lords, he opposed the notion of a uniform standard of purity for drainage flowing into a river, and contended that the river itself should furnish the standard, nothing worse than itself being allowed to enter. This proposal would render it absolutely impracticable to establish manufactures, *e.g.*, in the Lake District, or along the clear streams of Wales and the North of Scotland, whilst in South Lancashire and certain parts of the West Riding it would allow, for the time being, very considerable latitude. What I have to propose is merely an extended application of the same principle. Let England be divided into two classes of land, A and B. In A let manufacturers, if existing at all, be placed under the most stringent regulations as regards the pollution of the air or the water, or the piling up solid refuse of any kind. Thus the emission of any recognisable amount of hydrochloric acid gas, or of above a certain quantity of sulphurous acid, whether produced by the combustion of coal or otherwise, would be prohibited. The emission of dye, tan, or bleach liquids, &c., of spent dye woods or pulverulent refuse of any kind, riddlings or siftings of coal or other minerals, would have to cease. In districts B, on the contrary, rivers—provided they passed into the sea without flowing through any A district—might legally receive any industrial refuse, provided it neither gave off emanations injurious to human health, or choked up the bed of the stream and tended to cause floods. Smoke consumption

would be carried on so far only as was consistent with economical working. In the case of the escape of gases the same rule would be observed. If a farmer complained of damage to his crops he would then be told that if, of his own free will and choice, he preferred to occupy land in a B district, he must accept the inevitable conditions. In the same way, if a manufacturer thought proper to conduct his operations in an A district, and complained that the conditions required were ruinous, he would be told that by removing into a B district he would meet with every facility. In all this I can see no injustice, since both farmer and manufacturer would be freed from much annoyance to which they are each respectively liable under our existing promiscuous arrangements.

The two kinds of districts could be marked out without much difficulty. Those lands which lie over, among, or near the coal-deposits, or along the tideway of our navigable rivers and along the shore at their mouth, would fall under schedule B. We might include here all Lancashire except the Furness beyond Sands, the eastern half of Northumberland and Durham, the north-eastern margin of Cumberland reaching from Whitehaven to Silloth, the Yorkshire coal-fields, eastern Derbyshire, the whole probably of Staffordshire and Shropshire, the greater part of Warwickshire, and a portion of Worcestershire. In Nottinghamshire and Leicestershire the demarcation might possibly be not free from difficulties. In the London district ample margin might be secured for manufactures within a region beginning about Bow and extending eastwards between the Thames and the Chelmsford branch of the Great Eastern Railway, in addition to a much narrower strip of land on the south side of the Thames and about the mouth of the Medway. The coal-districts of Somerset, of South Wales, and of Flint would complete the B schedule of South Britain. Everyone must confess that within these limits three or four times the amount of manufacturing activity which we now exert could find ample room. The London district, to the north, the west, and the south, would be entirely free from noisome manufactures, whether chemical or mechanical. The southern counties, with the exception of the slip of North Kent just mentioned, would be entirely placed in schedule A. So also would the West, with the exception of the Somerset coal-district and the Cornish mining region. Norfolk, Suffolk (save about the mouth of the Orwell), the greater part of Essex, Cambridgeshire, the greater part of Lincoln, the north-west of Yorkshire, the

west of Durham and Northumberland, all Westmoreland, the greater part of Cumberland, Lonsdale beyond Sands in Lancashire, a considerable part of Cheshire, Derbyshire, Worcestershire, Hereford, and Monmouth, besides the midland counties bordering upon the Thames.

It is by no means suggested that all manufacturers should be proscribed in the A districts. To paper-mills and print-works, so long as they consume their smoke and run no refuse into the rivers, I see no reasonable objection. The same may be said of such chemical works as prepare fine products for photographic and pharmaceutical purposes. Nor need soap-works be banished so long as they do not melt raw tallows or use animal offal. The chief objection is to the alkali manufactories, to iron-, copper-, and lead-smelting works, large foundries, locomotive works, woollen and cotton mills, and all establishments which sulphurise the air by the sheer quantity of coal consumed.

The most rigid limitation should be placed upon the manufacture of explosives, which should be strictly confined to lonely places. It is too often overlooked that when a magazine explodes the shock does not travel merely through the air, but underground, producing in fact a veritable earthquake. In the great gun-cotton explosion at Stowmarket, in August, 1871, windows were observed writhing and falling to pieces at places distant about three-quarters of a mile from the magazine, *before* the sound reached the ears of the amazed spectators. Hence belts of timber, mounds of earth, &c., are of very little value as a protection to any adjacent property in case of a severe explosion. If we consider what havoc was wrought by the explosion of about 50,000 lbs. of gunpowder at Erith, we may feel astonished that the Home-Office should propose to sanction the storage of 10,000 lbs. of an explosive alleged by the patentee to be "from three to four times as strong as gunpowder," at the distance of about half a mile from a valuable dwelling-house.

Those who have had the painful opportunity of observing the effects of a severe explosion can scarcely come to any other conclusion but this, that no manufactory or magazine of explosives, save in the hands of Government, should exist within a clear mile of any human habitation, and that such establishments should moreover be so situated that the products may be delivered to shippers or consumers without the necessity of passing through London or any large city. For such branches of industry special parts of the B district should be set aside.

III. ON LIVING ORGANISMS WITH REFERENCE TO POLLUTED WATERS.

By J. W. SLATER.

IT is well known that the late Royal Rivers' Pollution Commission, in consequence of their observations and experiments, concluded that a river if once polluted with fœcal matter does not become purified by any natural process, at least within the length of any stream in the United Kingdom. Dr. Meymott Tidy, from a paper which he has recently communicated to the Chemical Society, holds, on the contrary, the opinion that rivers after contamination with animal or vegetable matter—excrementitious substances being necessarily included—are capable of self-purification, through the instrumentality of subsidence, of the absorption of oxygen, which is the more rapid the more impetuous the current, or by the agency of fish. It can scarcely, I think, be contended that fish can have any power of freeing water from dissolved impurities.

Some years ago an eminent French chemist came to conclusions very similar to those which have been made known by Dr. Tidy. He had proposed to estimate the relative purity of waters by the amount of free oxygen which they hold in solution and which he determined volumetrically by means of a standard solution of the "hydrosulphite" of Schützenberger and De Lalande. Among other waters which he thus examined were those of the river Vesle, above and below Rheims. As this town is the seat of very extensive woollen manufactures, the Vesle is polluted in a very similar manner to the Aire at Leeds, with both organic and inorganic refuse of the most varied kinds. He found that the water at the distance of some miles above the town contained a normal proportion of free oxygen. Approaching to Rheims and receiving the waste liquids of manufactories, it showed a smaller and smaller percentage, and a minimum was reached a little below the town. Afterwards, as the stream continued its course through an open agricultural district, the proportion of oxygen again increased, and at the distance of about twenty miles below Rheims—I quote from memory—it showed the same percentage as had been obtained above the city. At the same time he observed a series of changes in the organic forms inhabiting the river, which in his opinion proceeded step for step with the de-

crease and the subsequent increase of oxygen dissolved in the water. To these charges I must beg to call attention.

Above Rheims various kinds of fish were found in the Vesle, whilst aquatic vegetation of a fairly high type, *i.e.*, capable of secreting chlorophyll, was abundant. Water-weeds grew in the stream, and reeds and sedges flourished at its margin. Near, and especially within the town, these organisms disappeared. The fishes avoided, or perished in this part of the river, and in place of the green plants that inhabited the purer waters, growths devoid of chlorophyll made their appearance, among which figured the true "sewage-fungus." Below the town, as the quality of the water again improved and the percentage of dissolved free oxygen rose, the higher forms both of animal and vegetable life reappeared.

If the observations thus made are generally confirmed, two conclusions not without importance may fairly be drawn:—That the proportion of oxygen in the water of a river is causally and very simply related with the presence of the higher forms of animal and vegetable life; and that from inspection of such organism a tolerable approximate notion may be formed as regards the purity and the impurity of a stream. It has, indeed, been repeatedly asserted in French scientific journals, that water-cress can only grow in fairly good water. This assertion struck me as being little in harmony with my own observations and those of my friends. Mr. C. Cresswell, of Isleworth, a gentleman well-known for his zeal for sanitary reform, came upon a ditch which received the entire sewage and household refuse in general of a row of about a dozen cottages. Yet it was filled with the most luxuriant water-cress, which, sad to say, appeared to be regularly cut for sale. To decide the matter I carried on a somewhat extensive series of experiments at Aylesbury in the summer and autumn of the year 1878. Earth was placed at the bottom of four small movable tanks, and in each were planted healthy roots of water-cress. The tanks were then filled respectively with town sewage, undiluted and taken directly from the sewer-mouth; with water from a branch of the river Thame which flows past the town, receiving the drainage of manured and cultivated lands, and I believe sewage from scattered cottages in the upper part of its course; with sewage after treatment by the "A B C process," *i.e.*, precipitation with sulphate of alumina, clay and carbon; and lastly, with potable water. The loss by evaporation or leakage in each tank was made up by the regular addition of the same kind of water as had been taken

at first. The result did not admit of the slightest doubt: the water-cress planted in sewage not merely lived and grew, but far surpassed the other three lots in luxuriance and vigour, and continued so to do till the experiment was stopped by the frosts in the beginning of winter. Hence it may surely be concluded that the presence of water-cress in any stream or pond affords no proof of the purity of the water. It must be understood, however, that the sewage in question, though rich in fœcal matters, blood from slaughter-houses, &c., was perfectly free from manufacturing refuse. I have never heard of any instance of water-cress being found growing in any stream which receives the waste waters of chemical or dye-works, woollen-factories, &c. But as the sewage in question contained very much less free oxygen in solution than the potable water or the river water, it is plain that the growth of higher vegetation does not follow step by step the rising or falling proportion of oxygen. I may ask, indeed, why should it? It is almost needless to remind the reader that all plants which develope chlorophyll in their tissues liberate oxygen on exposure to sunlight. Hence aquatic vegetation is a cause rather than an effect of the presence of free oxygen in water, and its absence in highly polluted streams is due not to the deficiency of that particular element, but to some positive injurious agency, such as acids, alkalies, metallic salts, &c. In the absence of such plant-destroyers green vegetation is very efficient in freeing water from fœcal impurities. There are, of course, here certain limits; solutions of putrescent organic matter may be too concentrated to admit of vegetable life, just as liquid manures may be applied in too strong a dose. But this is a point rarely reached in any stream, and when chlorophyllaceous vegetation is absent we may generally seek the cause in the waste waters of some manufacturing establishment. Town-sewage when treated by any process which leaves in it a large proportion of any compound of lime, is also unfriendly to aquatic vegetation. The sanitary authorities of a large manufacturing town were advised by the late Mr. Smee to plant *Elodea canadensis* in the outer tank of their sewage-works, and to attempt the growth of reeds and sedges in the shallow waters along its margin. The advice was excellent, inasmuch as such vegetation would have completed the purification of the sewage. But as the process adopted involved the daily use of about fifteen tons of lime, it was not to be wondered at if the plants failed to survive. As far as I have observed, natural streams of very hard water are poor in aquatic vegetation.

But we must now turn to the growth which is considered most characteristic of polluted waters. Everyone talks of "sewage-fungus," and yet there are redoubted "sanitary reformers" and patentees of processes for the purification of sewage who have never seen this dreaded plant, and who suppose that it must have something of the appearance of a mushroom. This is a complete error; in form and colour it is not unlike a bundle of tow, with the fibres running parallel and ending in loose tufts. Suppose such a bundle fixed at one end to a stick or a stone or to the earth at some little depth under water, and swaying to and fro in the current, and you have a very fair resemblance of sewage-fungus. The chief difference is that this unholy and unlovely plant has a greater specific gravity than hemp, and tends to sink rather than rise if not kept in a horizontal position by the stream. The colour, too, is modified by the particles of dirt which get entangled in the fibres. What concerns us are neither the structure, nor the affinities, nor the chemical composition of this fungus, but the conditions under which it exists and its value as a sign of water-pollution. It is, in the first place, as far as I have been able to see and to learn, peculiar to running water. I have never seen it at the sides of any pond or reservoir whether of pure or of polluted water, nor at the bottom of such pools when emptied. If planted in an aquarium for experimental purposes it hangs straight down from the stick or root to which it has been found attached, and whether kept in the light or the dark it shows no disposition to flourish. Moving water is, therefore, essential to its growth. If preserved in the dark, however, it undergoes no change for months, and seems unaffected by the most powerful chemical agents except in enormous proportions. Chromic acid, for instance, is not reduced by it even on prolonged contact. If, however, sewage-fungus is placed in still water and exposed to strong light, green confervæ fix themselves upon it, overspread it, and seem gradually to effect its destruction. I have observed similar cases in shallow trenches in which partially purified sewage was flowing, but where water is still strongly charged with animal matter the fugus appears to hold its own, especially if the depth and turbidity of the stream interfere with the free action of light. It need scarcely be said that sewage-fungus is never found in pure mountain streams, or even in the brooks and ditches of rural districts which receive the drainage of cultivated lands, except they are connected with some sewer. But if portions of the plant are swept down out of a sewer—*e.g.*, by a violent storm of rain

—they are able to live in running water where the amount of pollution is exceedingly small—much smaller than the proportion specified as to be tolerated in the "recommendations" of the Rivers' Pollution Commission. If it be asked how this is ascertained, I reply that I know a small stream which down to a certain point is perfectly free from sewage-fungus, as I have satisfied myself by frequent and careful inspection. At that point it receives a stream of sewage, about one-sixth of its own volume, and purified to such an extent that one of the highest authorities on water-analysis, after repeatedly examining samples taken at haphazard, has pronounced it to fall well within the limits of the recommendations just referred to. Yet the stream, after receiving this infinitesimal proportion of fœcal matter displays here and there a tuft of sewage-fungus, along with a most luxuriant growth of green water-plants. It must further be noticed that on pursuing the stream for a few hundred yards the fungus disappears, its pabulum having possibly been destroyed by the oxygen evolved by the higher vegetation.

But whilst water may thus be too pure to supply the trace of nitrogenous nourishment required by sewage-fungus, it may be found, if not too impure, at least not to possess the right kind of impurity. I have made frequent and minute examinations of the sewage of Leeds, and of the results of the various processes which have been adopted for its purification, but I have never seen a trace of sewage-fungus either brought down the sewers from the town, or floating in the tanks, or fixed in the cut-flow channel, or where the latter opens into the river Aire. This absence was equally distinct whatever was the nature and the success of the process adopted.

Again, the London sewage at the southern outfall has never, in as far as I have had the opportunity of observing, contained a particle of sewage-fungus.

The same may be said of the sewage of Paris, which I have had prolonged opportunities of examining at Gennevilliers. On the other hand, a ditch at Wimbledon which received the sewage of the district, some of it treated and some in its original state, contained in the autumn of 1875 some beautifully characteristic specimens. At Aylesbury, after heavy rain, it has been swept down from the sewers of the town in great quantities, and at Hertford it has also been observed in great perfection.

Hence we may probably conclude that it grows by preference in the rich sewage of small residential towns rather than in the waste waters of the great manufacturing centres,

or in the dilute sewage of London and Paris. When once established, however, it is able to live on in relatively pure water, It need scarcely be said that this fungus, containing no chlorophyll, gives off no oxygen on exposure to light, and consequently contributes nothing to the purification of the water which it inhabits. It does, of course, withdraw a certain amount of organic matter from the water to form its own tissues, but this on its ultimate decomposition is restored to the stream. I am not aware that it is ever eaten by any animal—certainly not by fishes, insects, crustaceans, or mollusca. Infusoria swarm among its fibres, but probably as a place of shelter. Nor can I learn that it has ever been tried as an article of human diet. It might not be impertinent to express the wish that a certain gentleman who wrote to the papers proposing rats—foci of *trichinæ*!—as food for the destitute, would kindly make an experiment on sewage-fungus *in corpore vilissimo*. It is certainly nitrogenous, possibly nutritious and delicate, and just as possibly poisonous. I have frequently found this fungus growing to the bodies of dead fishes, floating in streams of doubtful purity, and I fear it is capable of attaching itself to these creatures whilst still living and bringing about their death.

We have now to turn to the animal world and ask whether the presence or absence of fishes can be said, in general terms, to be solely and mainly dependent upon the greater or smaller proportion of free oxygen in the water? That such oxygen is an essential of life for them must be known even to the most careless proprietor of an aquarium. We may therefore say that if oxygen is wanting fishes will be wanting also. But can we draw the converse inference, that if fish are wanting oxygen must be deficient? By no means; there are various substances which occasionally find their way into rivers, and which prove very extensively destructive to fish, but which are not likely to effect any decrease in the proportion of dissolved oxygen. We may take an instance given on very good authority, and briefly noticed in the "Journal of Science" for 1880, page 213. Dr. Auerbach, during an entire summer observed certain water-beetles—from his description probably the "whirligig" (*Gyrinus natator*)—living in tanks full of a saturated solution of sodium sulphate (Glauber's salt). When alarmed these little beetles dived down and took refuge among the crystals that were forming, just as they would do among the water-plants in a pool. But a little of this liquid, thus harmless to insects, happened to escape from the tanks by leakage and found its way along a ditch into a river at some distance,

where it proved fatal to a multitude of fish. It can certainly not be contended that a small quantity of such a solution, added to the water of a river, would either seize hold of and expel the free oxygen; yet we see that it turned the scale between life and death.

Cream of lime thrown into a stream will, as is known, seize upon carbonic acid, leaving oxygen unaffected. Yet this addition is well known as fatal to fish.

The presence of fish is certainly no proof of the absence of fœcal matter. At Kingston, just where the sewage of the town entered the Thames in 1875—it may possibly since have been diverted—I have seen fish darting about in numbers, and I learn that the sewer-mouth was a favourite spot for anglers.

Among amphibious animals frogs are found in pure waters, or in those but slightly polluted, and the same may be said of newts. If either excrementitious or manufacturing refuse is introduced in appreciable quantities they withdraw.

The presence of aquatic insects is not a character from which any definite conclusion can be drawn. When manufacturing refuse has been largely introduced they are generally absent. Thus, I have never seen either larvæ or adult insects in the Bridgewater Canal or the Irwell below Manchester, in the notorious Sankey Brook, in the Ayre below Leeds, the Kelvin Water, and similarly polluted streams. But in rivers largely fouled with putrescent vegetable refuse or fœcal matter they abound. On the other hand, in the very purest water they are necessarily absent as finding there no food. It would be interesting to find what is the minimum of impurity at which the larvæ of gnats and blood-worms (*Cheironomus plumosus*) are able to exist, and what is, if any, their maximum limit.

They are frequently found in water-butts and cisterns which have no other source of contamination but the organic matter suspended in the air. Still I should suggest that no water in which these larvæ are present should ever be used for domestic purposes, since their excretions, as far as I have been able to observe, set up in organic matter decomposition of an offensive and probably dangerous type. The character of their juices may possibly explain the irritating, and in some cases even dangerous, effects of the bites of gnats, mosquitoes, and pollution-fed Diptera in general.

Water-beetles, such as *Acilius sulcatus*, *Colymbetes sp.*, &c., and also certain Hemiptera, may be found in water which, from the absence of known sources of pollution and from chemical and microscopical examination, may be pronounced

potable. But they are also met with in pools fed by the surface drainage of manured fields and pasture lands. As a rule it may be said that animals which prey upon living animals or growing vegetables are not, in themselves, a bad symptom. All such as consume dead, comminuted, or putrescent matter, whether animal or vegetable, must be considered highly objectionable, as proving the presence of the bodies upon which they feed.

We may, therefore, probably conclude that neither vegetable nor animal life varies in any single relation with the proportion of oxygen found in a stream; that sewage fungus and all aquatic growths devoid of chlorophyll, where existing alone, indicate great pollution; but that where they occur along with green plants the impurities may be very trifling. Yet even vegetation of a relatively high grade, such as the water-cress, gives no positive proof that a stream is wholesome and potable. Lastly, it is impossible to argue from ordinary town-sewage to manufacturing-refuse, or to a mixture of the two. The influence of the former upon animal and vegetable life is widely distinct from that of the latter.

IV. THE INCONCEIVABLE AS A TEST OF TRUTH.

By F. H. Nash.

THAT all our knowledge is subjective is now looked on by a large number of those who think on such matters as a proposition proved. That this is equivalent to saying that knowledge in the true sense of the word is not to be attained by us at all, is at least to "our present reason" evident. That the same proposition logically involves general scepticism is not, however, my reason for calling it or its alleged proofs in question. If it be true let it stand. "*Fiat justitia ruat cœlum.*" Locke was no sceptic, yet his system, which referred all our ideas to experience, necessarily led to scepticism. Kant did not love scepticism, he desired to set up a barrier against it; yet he is supposed to have completely established the doctrine of the subjectivity of our knowledge, and may therefore be considered the father of such modern scepticism as deserves the name of

philosophy at all. Kant saw that Locke had totally failed, as all men must fail, in the attempt to trace all our ideas to experience. He admitted the existence of *a priori* ideas or principles of mind, independent of all experience. The admission of one such idea, on principle, is of course the annihilation of the empiric system. Kant taught that the phenomena of experience, meeting their *a priori* principles (which might as well be called innate), formed our knowledge, which was, therefore, the joint production of the Ego and the Non-Ego. Locke had compared the mind before experience to a sheet of blank paper. According to Kant's view it might be compared to the glass of the photographer, on which the picture is the joint work of the sun's rays and the preparation of silver. It may be worth observing that in this last case the outlines are true to external objects, while the colouring is false. Now whatever title we may give to these *a priori* ideas—primary, innate, connate, or necessary—the acknowledgment of their existence is fatal to the theory that all our knowledge is based on experience. Kant acknowledged their existence, and thus opened at least a chink through which Descartes might peep and see how much had been really added to mental science since his time.

But if our knowledge be not wholly founded on experience it may still (if it deserves the name) be founded on experience and our nature, and so be truly subjective. Whether it is so is the question before us. If we can know anything with the certainty that it ever was and ever must be true, irrespective of our existence or the actual existence of any given beings, then so much of our knowledge, be it never so little, is necessary truth—not subjective, but objective. If, on the other hand, there be no truth so certain but that, in a new sphere, or with new enlightenment, we might find it to have been an illusion, then all that we have by way of knowledge is subjective and possibly illusory. It cannot be called subjective because it is *in* us unless it also appear that it is *of* us. Are there then any Necessary Truths? Dr. Whewell's definition of necessary truths will suffice for my purpose. "Necessary truths are those in which we not only learn that the proposition is true, but see that it *must* be true, in which the negative is not only false but impossible, in which we cannot, even by an effort of imagination, or in a supposition, *conceive* the reverse of what is asserted." Here, *the inconceivable* is clearly admitted to be the test of the presence of a necessary truth, independent of ourselves. If then there be any proposition the contradictory of which is inconceivable, that proposition is true, and as part of our

knowledge is not subjective but objective. Although in us, it is not of us, but belongs to the eternal nature of things. It is not the Ego nor a part of the Ego. It has come to it, and it has not come from experience. It is as objective to the human mind as anything could be supposed to be to any other thing. But are there any such truths? And what is *the inconceivable?* It appears to me that this term has been used with wonderful negligence, even by most distinguished writers. Mr. Mill says that "inconceivableness has very little to do with the possibility or impossibility of anything in itself, but is a matter of accident and of the past history and habits of mind." Even Whewell abandons his own definition, and speaks of the existence of Antipodes and the Copernican system having been at one time "inconceivable." Spencer connects it with the result of human experience, and that leads us to the detection of the abuse of the word which renders it now *utterly useless* in philosophy, viz., the *confusion*, as I venture to call it, between the "conceivable" and the "believable." In like manner, Hamilton, in order to show that the "inconceivable" may sometimes be true, adduces this *dilemma*—"Either matter is infinitely divisible, or there is a limit to its divisibility, but we cannot conceive either." We certainly cannot realise either, or picture it to ourselves, or make it a clear object of contemplation. But this is not the sense of the word *conceive*, in which it can be of any use in philosophy, because in this sense, the conceivable is undoubtedly subject to accidental circumstances, and must be different in different men. But when the word is taken in its true sense, the case is quite different. Hamilton admits that there are two propositions absolutely true, quite independent of us, viz., that two contradictory propositions cannot at once be true, or at once be false. Although these certainly go but a little way toward enlightening us on the nature of things, yet they are of great value as supplying clear types of *the impossible*. That they are wholly independent of experience appears from this, that should a man be found to whom they were not self evident, the case would not for a moment be supposed an exception to a general consent, or a deviation from the "net result of experience," but simply as evidence sufficient of the absence of suspension of the reasoning power in that man. Such a man would of course be incapable of knowledge, and as to the conception of general ideas, would not differ from the brutes. Thus we obtain a very moderate test of the presence or absence of *reason*. This test will admit to the class of rational beings all men and women, educated or uneducated, civilized or

barbarous, who are completely human beings and not idiots. Idiots are persons incapable of perceiving that it is impossible that two contradictions should be either both true or both false: I take to be persons either without the faculty of reason or with the means of communication so deranged that we may imagine them to mean one thing when they seem to say or signify another, while we cannot determine that they conceive any idea at all. I would now define "the inconceivable" to be that which no one in possession of reason can entertain for a moment as possible, but must reject as repugnant to reason itself, as a contradiction which destroys itself, in which there is nothing to picture to the mind or to discuss "*vox et præterea nihil.*" If this be so, whatever was at any time inconceivable will be for ever so, and nothing that has ever been conceived was at any period or by any other persons inconceivable. What men could be persuaded to believe, or even to entertain as possible or probable, has always varied with the circumstance and will always vary; but before these questions of possibility, probability, or credibility can arise, the mind must first be able to *conceive* the proposition, that it does not in the expression destroy itself. It must stand before the mind as possible under some circumstances, even if it is to be condemned as impossible under the existing or supposed circumstances. The ancients, who are erroneously said to have been *unable to conceive* the existence of Antipodes, because they refused to believe it, had their attention been drawn to some flies walking on the ceiling, just as others walked upon the table, would have replied that men were not like flies, a direct appeal to experience. They conceived the proposition, but they rejected it on account of certain objections. The same is true of other ordinary illustrations of the "inconceivable." But we have here the means of giving a clear definition of it, and thus restoring the term to usefulness. The man who can comprehend the general proposition, that of two contradictions both cannot possibly be true, nor both false, anywhere or in any state of being, is possessed of reason. The man who cannot comprehend this as a general proposition is destitute of reason. "The inconceivable" is that which every man possessed of reason is *ipso facto* compelled to reject as incapable of being presented to the mind as a supposition, as involving the negation of that understanding which was to consider it as in fact self destructive. It is on this ground, and on this ground *only*, that Sir W. Hamilton can affirm his two proposition, that their contradictories are to this exact extent *absurd*. To say,

therefore, that these propositions are certain, and that we have no other certain knowledge, is to say that there is no other proposition for which we would claim certainty, of which the contradictory is not *conceivable* in the sense which I have proposed for that term. All those, therefore, who assert that we have not the like certainty of any other proposition, are bound, if any proposition is offered to them as of equal certainty, to be prepared to say that they can and do conceive the contradictory of that proposition as possibly true in some other sphere and possibly apparent in another state of enlightenment. If reason absolutely refuses the possibility of the contradictory, it *ipso facto* affirms the independent and absolute truth of the proposition. To illustrate this, let the idea be that of a man reclining in a blast-furnace drinking melted marble; or of a temperature that would freeze the flame of a lamp, so that it should be gradually forced upward in the form of a pellucid cone; or of hydrogen stored in blocks to be split up for fuel, or of preserving the heat of the dog-days in casks to temper the severity of the winter. These ideas are quite opposed to experience, but there is no contradiction present. They are conceivable. Again, a region where the attraction of gravity was replaced by repulsion, so that houses had to be screwed into the ground, &c.; or where people were born in a state resembling old age, and after passing through maturity, youth, and childhood, *attained* to infancy and then died; or where a man could detach a diseased organ from his body and leave it with the physician for repair as he would his watch with the watchmaker. All these are ideas which experience does not aid us to realise, but reason stands neutral. There is no contradiction; they are not inconceivable, therefore not necessarily false; and a rational man is bound to say that such things *could be*. Any conviction that we may feel that they are not is only subjective, or, in plain English, matter of *opinion*. But let the suggestion be of a region where things and conditions of things begin to be, without *anything* making them begin to be; or where things can be conscious of thought without existing; or where a number of lines in one plane, intersecting at one point, can make angles exceeding in sum those made by the first two; or where there can be merit without intention, or guilt without free will; or where there may be limits to space and no space beyond those limits, that is to say, beyond those limits neither something nor nothing; or where there is no duration or succession, but all things are simultaneous; or where there is no number, but 1000 may be sometimes more,

sometimes less than 10, and a product of 62 may be obtained indifferently from the factors 6 and 2, 8 and 11, or 29 and 3. Those who would limit our absolute knowledge to the one single proposition (expressed by Hamilton in *two*, under the sounding names of contradiction and excluded middle),* "That which is, is" are bound to say that these last suggestions, to which many more might be added, *can be true*, that they involve no contradiction to *their* reason. Rational man, however, *knows* that they are absurd and self-destructive; that reason stamps them out of the nature of things, and consequently their contradictions are true if we had never existed; nay more, that if the universe itself, with its Author, could cease to exist, they would remain potentially true for ever. They would not be knowledge while there was no mind to know them. But should, *per impossibile*, a mind come into being, it would *find* them true, and that time and space had been waiting during the interregnum for landmarks and apportionment. It may be observed with regard to two of these propositions, that some maintain that our idea of merit and demerit is merely the result of a calculation of expediency which has become in some inexplained way a part of our nature. This is immaterial; it is sufficient that we have the ideas of *duty* and *interest*, as distinct from one another as that of either from that of a triangle. This is matter of universal conscience, and the theory has been so often rejected that no one is supposed really to believe it, but to repeat it only as harmonising with his system, or under the impression, strangely prevalent in these days, that by piling "it may be" upon "it may be," we are approaching the proposition that "it is."

With regard to the whole group of propositions which can be proved by the test of the inconceivable in this sense of the term, it would appear that the actual existence of but two beings can be so established, that of the thinking mind by consciousness, and that of God by causation. The number of general propositions which can be associated with this absolute certainty, and their bearing on other matters of belief, are topics on which of course I cannot enter here. I conclude by stating in a few words the position that I have meant to establish. If it be (as is admitted) absolutely true, independent of experience or any thinking mind, that of the propositions all A is B, and some A is not B, one must be

* Mr. Mill endeavours to make it appear that there is a third alternative when the proposition is "unmeaning," the predicate not being in itself predicable of the subject—as "Constitutional Government is blue;" but if it be not predicable, the *negative* is obviously true, if there be a meaning in the words at all.

true and the other false; this is certain only because the opposite of it, that both may be true or both false, is submission of reason itself. Hence it follows that if of any other pair of contradictories one be equally subversive of reason itself, that is to say if it be "inconceivable," then the other is *true*, independent of all experience, or of any thinking mind; to which mind it is wholly external and objective. I think that I have shown that such propositions there are, and that a certain amount of objective knowledge is ours, even in the present existence; that we are not tossing adrift in a chaos of illusory forms, but that while our view of surrounding objects in general is undoubtedly modified by the medium through which we perceive them, *our feet nevertheless stand on a rock, narrow it is true, but immovable.*

V. EXPERIMENTS WITH THE "JUMPERS" OF MAINE.*

By George M. Beard, M.D.

(Concluded from p. 93.)

BEFORE I visited Moosehead Lake, while I knew only those facts that were obtained at second or third hand, I felt quite sure that this disease would be likely to be a family inheritance. This deductive reasoning was confirmed by inductive observation. It is fully as hereditary as insanity, or epilepsy, or hay-fever, although it has no special relation to any of those forms of disease. In the family of one of those with whom I experimented there were five Jumpers, the father, two sons, and two grandchildren of the respective ages of four and seven years. In the family of another with whom I experimented there were four, all brothers. In the family of another of whom I obtained information, but did not study, there were three cases, an uncle, a mother, and a brother. In another family there were two boys, both Jumpers. Here, then, were fourteen cases in four families. By the study of these cases it was possible to trace the malady back at least half a century.

Endemic and Contagious.—Jumping seems to be endemic, confined mainly to the north woods of Maine and to those of French descent, and is psycho-contagious—that is, can be caught by personal contact, like chorea and hysteria.

Shortly after I began these researches, I found in a copy of the London "Medical Record" brief reference to precisely similar phenomena on the other side of the globe, among the Malays. The notice was very brief indeed, but it was sufficient to show that there was no difference in the phenomena as exhibited in these different races. I have been told that in northern Michigan these Jumpers are to be found, but have obtained no evidence on that point that is entirely satisfactory. It would not be improbable that this assertion should be proved to be true, since the class among whom Jumpers are found is somewhat migratory, although not so much so as the English and Americans.

Origin and Philosophy of the Disease.—Jumping is probably an evolution of *tickling*. Some, if not all, of the Jumpers, are ticklish—exceedingly so—and are easily irritated by touching them in sensitive parts of the body. It would appear that in the evenings, in the woods, after the day's toil, in lieu of most other sources of amusement, the lumbermen have teased each other, by tickling and playing, and startling timid ones, until there has developed this jumping, which, by mental contagion, and by practice, and by inheritance, has ripened into the full stage of the malady as it appears at the present hour. This theory is in harmony with the general facts of physiology, and explains, better than any suggestion that has occurred to me, the history of what would otherwise appear to be without explanation, and almost outside of science. In a certain sense, we are all Jumpers; under sudden excitement, as of a blow, or a violent, unexpected sound, any person, even not very nervous, may jump and cry, somewhat as these Jumpers do, though not with all the manifestations of the Jumpers. Hysterical women, jumping and shrieking on slight excitement, we have all seen.

Everything about this subject is incredible. I do not expect that my readers will believe all, if they believe any, of what is here reported; rather they will find it easier to believe that I have been deceived; that the six sources of error that are involved in all experiments with human beings, were not fully eliminated; that the Jumpers, in short, experimented with me, and not I with the Jumpers; and that through all of this half century, the guides and physicians, the proprietors of hotels, and their neighbours, and relatives, and friends, have been the victims of intentional or unintentional fraud. But to my own mind the most incredible fact of all is, not the existence of the phenomena, but that the phenomena have not been sooner observed by science, and

that they have so long escaped the notice even of scientific men who live near or in those regions, and who frequently visit them.

Two of the best known citizens of Greenville—a town at the foot of Moosehead Lake—who have lived there very many years, if not all their lives, who have had these Jumpers in their employ, denied or doubted the existence of any of these phenomena, declaring that these so-called Jumpers were merely drunk or playing. My guide in the woods of northern New Hampshire, who had spent his whole life in those wilds, who was old enough to be a great-grandfather, denied, without reservation, the whole claim; but, after investigating the subject with me, was compelled to admit its genuineness. One of my fishing companions in the woods, a clear-brained and vigorous man of business, and a man of the world, who, for seventeen years had passed his summers in these regions, knew nothing of the subject until this season when I called his attention to it. All around these districts there are physicians, not in them but near them—for in the summer season the umpers scatter, to a certain degree, over the farms in the vicinity—and every year physicians and men of science, experts in various realms, visit for recreation the districts where these Jumpers most abound; but if they see them they do not notice them, or if they notice them they do not understand them, or if they understand them they say nothing about them, and do not attempt to bring, or at least do not succeed in bringing, the phenomena into science.

ANALYSES OF BOOKS.

*Vivisection, its Opponents and Richard Wagner.** By WILHELM JENSEN. Stuttgart: Levy and Müller.

THIS little work opens with a humorous but faithful account of the rise of the present most lamentable agitation. The author remarks that in all times cases have occurred when the great conflict between Reason and Folly suddenly concentrated itself in some region which had hitherto remained in peace. Such, till lately, was the position of Physiology, pursuing quietly her course, whilst the merits of her labours were hidden behind those of the medical practitioner, who applied her results to the service of mankind. But few years ago the layman who should have presumed to prescribe to physiologists what methods of research should be adopted, and what should be avoided, would have been generally, and justly, pronouuced insane. Suddenly there has broken out, especially among nations of Germanic descent, a mental epidemic which reminds us, *e.g.*, of the dancing mania in the Middle Ages.

Physiology has been accused and condemned in the same breath in a manner which in mendacity, stupidity, and effect among the ignorant equals the agitation concerning the Marpinger miracle. Profs. Heidenhain, Herrmann, and Virchow have indeed put forth pamphlets in defence of the liberty of research, but the majority of physiologists have thought it beneath them to defend their cause in non-scientific organs. Such conduct, however, at least as far as England is concerned, is a serious error. A vast majority of the public never read scientific journals; they meet consequently with no exposures of the misrepresentations circulated in literary and political organs by professional agitators and anile sentimentalists, and thus we are in danger of being overpowered by organised ignorance.

Our author proceeds to give a definition of vivisection which is logically correct, but differs greatly from that adopted by our essentially illogical sentimentalists and law-makers. In their eyes every "painful experiment"—or rather every experiment which they pronounce painful—is vivisection, even though no "section" at all should take place. Thus the British toxicolgist is deprived of the use of an occasionally useful method of recognising poisons. He may not, *e.g.*, administer to a rabbit or a Guinea-pig an extract obtained from the contents of the viscera of a person supposed to have been poisoned, in order to

* Ueber die Vivisektion, ihre Gegner und Herrn Richard Wagner.

conclude from the symptoms produced the nature of the substance administered. Here lies one of the grossest errors of the anti-vivisectionists; they declaim against the barbarity of "cutting animals up alive," and then include under this category operations such as those involved in the researches of Pasteur!

Herr Jensen raises two questions:—Has man the right to dispose of the life of animals for his advantage? and, if this be conceded, is the benefit derived from vivisection so great that the apparent cruelty of physiologists becomes in reality benevolence? The first point, man's right over the lower animals, he considers cannot be proved, but that it can be legitimately called in question only by that very rare being the consistent vegetarian, who renounces milk "because it cannot be obtained without keeping the cow in an unnatural condition, who allows himself to be bitten by a mad dog rather than knock out its brains, who looks on calmly while his goods and chattels are gnawed by mice and rats, who regards bug- and gnat-bites as justifiable peculiarities of our earth's existence, and who does not blame the cook if she serves up fragments of cockroaches in his coffee." Such a man, and such only, can logically and consistently denounce vivisection! It is edifying to think that if we "move on" in the direction we have now for a few years selected, such men will form a powerful interest in the State, and may even rule over us. Fanatics of all grades are ever ready to join hands against rational men. If the anti-vivisectionist reply that he objects not so much to the rapid death of animals for man's convenience as to their prolonged existence in a state of mutilation and pain, the author is ready with an overwhelming answer. Throughout Europe there are millions of animals which are mutilated for the good of their possessors by means of a painful operation, and which for the rest of their lives remain mere shadows of their natural selves. Our humanitarians might further see sheep newly-shorn and trembling with cold; pigs, capons, and geese crammed to immobility and suffocation. All this torture is inflicted upon millions of unoffending animals for the convenience of man. Yet no benevolent society is formed to combat the "horrible sin," either by sensational pamphlets or by stirring up the mob to deeds of violence!

The author then proceeds to show that the benefits of vivisection for the present and the future race of mankind, for the development of science and of practical medicine, are so great that the sacrifice of a few animals must be regarded as, in comparison, utterly insignificant. He reaches the legitimate conclusion that they who seek to obstruct the progress of science with slanderous accusations must belong to one out of two contemptible classes of beings.

Passing from defence to attack, Herr Jensen traces the origin of the anti-vivisection outcry among the aristocracy and clergy of England. He argues that the latter opposed vaccination and

ever the hybridisation of plants, and that, in seeking to check the progress of biological research, they are fighting against their most dreaded enemies—the inquirers into the bodily and spiritual vital conditions of man. We fear that the author here forgets how "free thought" has, in the person of one at least of its champions, joined the motley army of anti-vivisectionists. He then passes on to show the gross inconsistency of the aristocratic and sporting opponents of physiological research. He paints in glowing colours the holy alliance between Exeter Hall and Hurlingham. Though some of his charges against the pursuits of our country gentlemen relate rather to the past than the present, it must be admitted that one of their old sins—cock-fighting to wit—has lately experienced a revival. From England the "germs" of the agitation were carried over to Germany, and found an apt nidus in a certain Ernst von Weber, a "knight of high orders, possessor of the Imperial Austrian medal for Art and Science, member of the council of the Dresden Society for the Protection of Animals," and author of "The Torture-Chambers of Science"—a pamphlet admirably adapted to the comprehension of the class of people which at Leipzig burst into and demolished the Physiological Institute! The writings and speeches of this man have met with more acceptance than might have been hoped in Germany. But even in that country the entire population does not consist of enlightened thinkers. It is very much to be regretted that among the dishonourable means employed by the anti-vivisectionists has been a species of forgery. Thus Sir Charles Bell, Darwin, and Rockitansky are alleged to have declared vivisection useless for Science. The author shows the untruthfulness of these statements, and quotes textually a document signed by Charles Darwin, and dated 1876, addressed to the Leipzig Physiological Society.

The statement that both in England and Germany "practical physicians" have pronounced vivisection unnecessary is severely but truthfully encountered. The very same kind of practitioners—routine prescribers and fee-takers—reject the application of physical, chemical, and microscopic research to the art of healing, and in fact dispense with physiology altogether. There are a certain class of medical men who, having spent the best part of their college years in the tavern and the fencing-school, by some marvellous turn of luck slip through the "State examination," and are duly authorised to angle for patients. How are such men to earn a livelihood in an over-crowded profession where even great merit may not be recognised until too late? The choice lies for them between hunger and quackery, and we need not say which alternative they select. They become homœopaths, hydropaths, anti-vaccinationists, anti-vivisectionists, or anything which may flatter the ignorance and the prejudices of the public. Such are the greatest part of the medical practitioners who for the sake of popularity are willing to compromise the advance of Science.

As for Richard Wagner, he proves to be the opera-composer of Bayreuth—a man utterly unqualified to decide on such a subject, and really not worth half the notice which Herr Jensen bestows upon him.

The work before us deserves, as a whole, the approval of all friends of Science. We wish that some publication of a similar kind, adapted of course to the different state of circumstances in England, could be widely circulated in our country, in order to open the eyes of the public.

Peruvian Bark. A Popular Account of the Introduction of Chinchona Cultivation into British India. By CLEMENTS R. MARKHAM, C.B., F.R.S. London: John Murray.

IT will be difficult for any Englishman to read this narrative without mingled feelings of triumph and regret, even of humiliation. We see, on the one hand, a great and noble national enterprise, worthier far than was ever sung by epic poet of old, carried to a successful conclusion. We read the history, as it were, of a victorious campaign waged against fever, and of an increase in the material resources of one of the most important sections of the British empire. Yet, on the other hand, we learn the sufferings and the neglect which have been the reward of the devoted band by whom such splendid results have been achieved.

The general public is, of course, aware that the various species of trees of the Chinchona family are of exceeding value to the human race as being the source of quinine, now one of the most indispensable requisites of the physician. These trees are naturally found on the eastern slopes of the Andes, from the Bolivian province of Cochacamba in 19° S. into Colombia, a distance of 1500 miles. For more than two centuries the whole supply of Peruvian bark had been drawn from these forest regions, without any attempt at systematic cultivation. The wandering *Cascarilleros* stripped the bark from the trees, and left them to perish. Such a system persistently followed could have but one result, even in the luxuriant climate of South America, and as the demand for quinine has been on the increase over the whole world it became evident that the price of this invaluable remedy must soon rise so high as to put it out of the reach of all but the wealthy. It was therefore resolved to attempt the introduction of the Chinchona trees into India. By this step it was hoped that the supply of quinine and its kindred alkaloids would be greatly increased, the price kept within reasonable bounds, and the people of India would be supplied at an easy rate with a

medicine without which even the natives find the maintenance of health difficult in certain districts. All these hopes, we may say, have been fully realised.

On the other hand, the difficulties to be encountered were most serious: young seedling trees had to be sought and dug up in the midst of trackless and often pestilential forest regions, and conveyed for hundreds of miles to a sea-port for embarkation. The jealous and ignorant natives looked upon the enterprise with decided hostility, and the tree-hunters were in considerable danger. One Manuel Marten threatened to stir up the people to seize them and cut off their feet! The young trees had next to be placed in Wardian cases for embarkation, and conveyed to their destiny. Mismanagement in high quarters was not wanting. It might naturally have been expected that our Government would have had vessels ready to convey the precious plants directly across the Pacific to India. This rational step was not taken. H.M. steamer *Vixen* was allowed to be idle at Islay whilst the plants were shipped for Panama, conveyed across the isthmus, shipped again for England, and despatched thence to India *via* the Red Sea, being thus exposed to the greatest possible vicissitudes of climate. On reaching India the difficulties were far from being at an end. It was necessary to select localities for the intended plantations resembling their native regions as closely as possible in latitude, altitude, temperature, rainfall, soil, &c. With care and patience the task was accomplished, and the result may be summed up by saying that every valuable species of Chinchona known in South America has been introduced into India.

The original object was to bring a cheap febrifuge within the reach of the mass of the people. This has not merely been effected, but the enterprise has proved a most profitable public work. The sums expended have been repaid with interest, a large annual profit to the State has been realised, a valuable product has been established in India and Ceylon, and a new and important supply of bark for the European market has been created. India now stands second in quantity among the bark-exporting regions of the globe, and in quality it is the most important of all. Samples from the Nilgin plantations have fetched 15s. 8d. per lb., the highest price ever obtained.

It must never be forgotten that this brilliant success, like most British triumphs either in peace or war, has been earned not by the forethought or the organising capacity of Government, but by the energy, the tact, and the devotion of individuals. How have these individuals been rewarded?

Among the most active of Mr. Markham's coadjutors was the eminent botanist Dr. Spruce, to whom fell the task of collecting the plants and seeds of the "*succirubra*" species, which now yields an annual income of many thousands. He returned to England in 1864, an invalid for life, and incapacitated from fol-

lowing his profession. In 1865 he received, after earnest appeals to Government, a pension of £50 a year from the Home Government, and in 1877 a further sum of £50 a year was added by the Indian Government.

Mr. Cross, the introducer of *C. officinalis*, made six expeditions, encountered great dangers, and suffered repeatedly from fever. The sums he has received have barely covered his expenses out of pocket. On his final return to England, in 1879, he received two sums of £300 each for about nineteen years' service.

Mr. John Weir, the gardener, was a most important element in the success of the undertaking. Without his skill and knowledge it is very doubtful whether the young plants would have been shipped in a healthy condition. In 1865 he was brought back to England a cripple for life, and had no resources save the interest of £600 collected for him by the Fellows of the Horticultural Society, and his wife's earnings. Mr. Markham's urgent appeal for a small grant in recognition of Weir's excellent services was refused. What statesmen or what administrations are responsible for such injustice we do not care to ask; but we cannot hear without shame and indignation of such treatment being meted out to men who have deserved so well of their country.

Mr. Markham's work is full of interesting observations, botanical and climatological, both respecting South America and India, and will be read with delight by all lovers of adventure and enterprise.

The Journal of Speculative Philosophy. Vol. XIV., No. 3. New York: D. Appleton and Co.

In this number our attention is especially called to a highly original article by Mr. Payton Spence, entitled "Atomic Collision and Non-Collision, or the Conscious and the Unconscious States of Matter; a New Theory of Consciousness." The author shows, in the beginning of his memoir, that consciousness seems to stand abruptly apart from the world of matter and its phenomena; that it "has hitherto no scientific genessis." He thinks that matter exists in two states, a negative and a positive, the latter being induced by the collision of atoms, and varying indefinitely in degree. Here, then, we have the "conscious and the unconscious universe—the negative being the unconscious, and the positive the conscious." He uses the term conscious in a wider sense than is usual, embracing under it "not only human and animal consciousness, as is generally done, but also in-

cluding all degrees below that of human and animal consciousness, as well as all degrees above it." He holds, therefore, that mind runs deeper down into matter than is generally supposed. Having identified force with consciousness, he asks if we have still an irreconcilable duality? In reply he maintains that consciousness is an ultimate fact which cannot be surrendered,—that matter is that something whose modifications are states of consciousness. "In the act of atomic collision matter and consciousness, the thing modified and its modification, are causally and efficiently related. Hence matter and consciousness are in their ultimates the same, and consciousness is the ultimate, unitary cosmic constituent.

We regret that space does not enable us to develop the author's argument at length.

John Hopkins University, Baltimore. Studies from the Biological Laboratory. "The Development of the Oyster," by W. K. Brooks, Associate in Biology. No. IV. Baltimore: J. Murphy and Co.

We have here a very valuable monograph. The author finds, in the first place, that, as regards the American oyster of the Chesapeake Bay, the ova are fertilised not within, but without, the body of the parent—an important difference from the European species. After describing the general anatomical characters of the species, he passes to an account of his experiments on the artificial fecundation of the ova. In connection with this subject he finds that the American oyster, like its European congener, is not a hermaphrodite; but he states that there is some reason for the belief that an oyster may produce eggs one season and sperm-cells the next.

The author has very carefully studied the development of the young brood, and it is to be especially noted that he finds them pass through a distinctly-marked "gastrula" stage. Mr. Brooks has unfortunately failed in tracing the process by which the swimming embryo becomes converted into the sedentary adult. The chance of a young oyster reaching maturity has been calculated by Möbius at 1 in 1,145,000.

The author remarks that the general occurrence of a gastrula stage in so many widely separated animals is certainly the most pronounced feature in embryology, and it is possible that a more complete acquaintance with the development and the phylogeny of the Mollusca may show that the facts held do not in reality oppose the view that it is an ancestral form. But our knowledge of facts, he adds, must be very much greater before we are

qualified to lay down any general hypothesis on the ancestry of the Metazoa.

A separate memoir is devoted to the acquisition and loss of a food-yolk in Molluscan eggs.

The English Universities and John Bunyan, and the "Encyclopædia Britannica" and the Gipsies. By JAMES SIMSON. New York: James Miller. Edinburgh: Maclachlan and Stewart. London: Baillière, Tindall, and Co.

THE title of this little work seems to require some explanation. The author maintains that John Bunyan was a Gipsy, or at least of Gipsy origin,—a question possibly of interest to the literary world, but which does not in any way fall within our jurisdiction, —and he appeals to the Universities of England, and to all connected or who have been connected with them, to discuss this point. Mr. Simson then criticises an article on Gipsies in the "Encyclopædia Britannica," from the pen of Mr. F. H. Groome. A passage which the author quotes from Lord Macaulay should not be passed over without solemn protest. Says the great Whig historian :—"Though there were many clever men in England during the latter half of the seventeenth century, there were only two great creative minds. One of these minds produced the 'Paradise Lost,' the other the 'Pilgrim's Progress.'" The writer here very characteristically ignores a mind which produced the "Principia"—of far greater value than the "Paradise Lost" and the "Pilgrim's Progress" put together.

The ethnological questions involved are from our point of view much more important. To us it seems unreasonable to expect social equality for a strange race which has obtruded itself uninvited into European countries, so long as it refuses to become merged in the great body of the people. A distinct caste, if not a dominant aristocracy, must take the rank of Pariahs. To an absorption of the Gipsies we can see no objection.

Popular Lectures on Scientific Subjects. By H. HELMHOLTZ, Professor of Physics in the University of Berlin. Translated by E. ATKINSON, Ph.D., F.C.S. Second Series. London: Longmans and Co.

THE subjects of the Lectures contained in this series are—"In Memory of Gustav Magnus," on the "Origin and Significance of Geometrical Axioms," on the "Relation of Optics to

Painting," on the "Origin of the Planetary System," on "Thought in Medicine," and on "Academic Freedom in German Universities." Not many living men would venture to discourse before learned and critical audiences on so wide a range of topics, and no one probably would acquit himself so satisfactorily. But whilst we recognise the full value of the teachings of Prof. Helmholtz, we cannot but pronounce him a dangerous example for the student. The versatility which he exhibits is not shared by one mind in a million.

Prof. Magnus may be regarded as having done for physics what Liebig did for chemistry. The modern physical laboratory arranged for experimental instruction in optics, heat, electricity, magnetism, is his creation. His collection of apparatus, which on his death he bequeathed to the University of Berlin, is a silent but emphatic testimony to his character. Every instrument is not merely the best procurable, but every requisite which may be wanted in the course of experimentation is sure to be close at hand. As a teacher he constantly urged upon his pupils the appeal to observation and experiment. He did not recognise the absolute distinction formerly admitted between the organic and the inorganic world, but, as Prof. Helmholtz says, "in his research on the gases of the blood (1837) he dealt a blow at the heart of vitalistic theories." He is described as having led an especially happy life in the centre of an affectionate family, and in a circle of faithful and distinguished friends, whilst his circumstances allowed him to devote his whole time to successful research.

In the lecture on the relation of Optics to Painting we find mention of a remarkable fact: the brightest colours of a painter are only about one hundred times as bright as his darkest shades. The brightest white on a picture when most brilliantly illuminated has probably one-twentieth of the brightness of white directly lighted up by the sun. On the other hand, white garments in moonlight or marble surfaces will always be from ten to twenty times as bright in a picture as in reality.

In the concluding portion of the lecture on the origin of the Planetary System, Prof. Helmholtz speculates on the possible extinction of organic life upon our earth. He seems to think it probable that animal forms may be developed capable of existing amidst the decreasing heat and light which must be expected in the remote future. He entertains the suggestion that meteoric stones may scatter germs of life in new worlds—a view which has involved him and Sir W. Thomson in a controversy with Prof. Zöllner. But we do not see that this hypothesis serves in the least to explain the origin of life. We have still the alternative, creation or spontaneous generation. If the latter is impossible in our world, why should it take place elsewhere?

As regards individual consciousness the author says—"As yet we know of no fact which can be established by scientific ob-

servation which would show that the finer and more complex forms of vital motion could exist otherwise than in the dense material of organic life. True; we cannot demonstrate or even conceive of an organised gas or organised ether, and yet he adduces certain analogies which may point to a different conclusion. He says, "The observer with a deaf ear only recognises the vibration of sound as long as it is visible and may be felt, bound up with heavy matter. Are our senses, in reference to life, like the deaf ear in this respect?

The lecture on "Thought in Medicine" gives some striking instances of the amusing arrogance of metaphysicians. "Schopenhauer calls himself a Mont Blanc by the side of a mole-heap when he compares himself with a natural philosopher."

It must be remembered that Prof. Helmholtz distinguishes between metaphysics and philosophy. He lays down the principle that a "metaphysical conclusion is either a false conclusion or a concealed experimental conclusion."

The discourse on "Academic Freedom in German Universities" is not laid before the reader in its original state. With the consent of the author, the translator has omitted some passages and modified others which he considers would convey an erroneous impression of the state of things as now existing in Oxford or Cambridge. It may still, however, be questioned whether the alterations in the English Universities approximate them tangibly to the German system. If Science is taught, it is taught as something to be examined in, not to make discoveries in. Of no English University can it be said, as Prof. Helmholtz truly says concerning those of his country, "Scholars speaking the most difficult languages crowd towards them, even from the farthest parts of the earth."

The author remarks that in college lectures, both in England and France, greater weight is laid upon eloquence than in Germany. It seems to us that our national worship of rhetoric, and the extent to which we are swayed by it, is a grave element of weakness.

There are few persons who cannot reap benefit and instruction from the work which we have thus briefly endeavoured to sketch.

Tables for the Analysis of a Simple Salt, for Use in School Laboratories. By A. VINTER, M.A. London: Longmans and Co.

"THE cry is still they come!" We have often groaned in spirit over the fertility of the English press in elementary works on chemistry, and wondered how long professors and teachers will go on trying to give us old facts and doctrines with a new face.

Germany has far more chemical schools than England. The number of her professors and teachers is greater; yet it is doubtful if she produces a tithe of our number of manuals. How is this? Are such works a by-product of the examination system?

---

*History of Plastic Art from the most Ancient Times down to the Present.** Third Edition, enlarged and revised. Vol. I. Illustrated with 277 Wood-engravings. By WILHELM LÜBKE. Leipzig: E. A. Seemann.

WE have here the first volume of a very thorough-going and elaborate history of plastic art in the widest sense of the words. The author gives, in the first place, a brief survey of art in India, Egypt, the empires of the Euphrates, Asia Minor, Syria, and Cyprus. His main attention is of course given to classic art, which he traces from its origin to the overthrow of the Roman empire. Not merely the statues and architectural decorations are described according to their characters, but the coins, medals, gems, and other art-work in metals, ivory, &c., are treated in an appreciative manner.

The last section of the volume is devoted to the Byzantine and Mediæval art down to the twelfth century. In noticing the rise of so-called Christian art, the author points out very clearly that the asceticism of the times amounted to a formal war against beauty alike in art and in nature. Indeed one of the great merits of Herr Lübke's work is that he treats of the successive phases of art not as mere isolated phenomena, but as having their roots in the moral and social life of the times, and as instinct with the spirit of their civilisation. Consequently, while this work may be most profitably studied by the artist, and by those engaged in art-manufactures, it is also of high value for the historian, the philosopher, and the student of social science. The Ramses of Egypt, the Aphrodite of Gnidos, and the Virgin of Czenstochowa is each the exponent of its age and country.

An Examination of the Double-Star Measures of the Bedford Catalogue. By S. W. BURNHAM.

A REPRINT from the "Monthly Notices of the Royal Astronomical Society" (xl., No. 8). The author criticises the measure-

* Geschichte den Plastik von den eltesten Zeiten bis zur Gegenwart.

ments of Admiral Smyth, as given in the "Bedford Catalogue," and considers that Class II., *i.e.* double stars not previously measured by any other observer, are not perfectly satisfactory.

Transactions and Proceedings of the Royal Society of Victoria, Vol. XVI. Issued April 30, 1880. Melbourne: Mason, Firth, and M'Cutcheon.

THIS volume opens with the interesting Anniversary Address delivered by the President, R. L. J. Ellery, F.R.S., the Government astronomer. The author criticises the theory which connects the periods of sun-spots with commercial crises. He pays a well-deserved tribute to the merits of the Government botanist, Baron von Müller, with especial reference to his valuable memoirs on the "Forest Resources of Western Australia" and on "Select Industrial Plants." The President expresses a regret, in which we fully participate, that the biological and medical sciences are less cultivated in Australia than mathematics and physics. This is exactly what ought not to be: mathematical and physical research can be carried on as well, or better, in Europe; whilst biology, ethnology, geology, &c., present many questions which can be successfully attacked in Australia only.

Mr. Ellery has also contributed a memoir on the "Relation between Forest Lands and Climate in Victoria." He arrives at the important, and we believe sound, conclusion that "the indiscriminate clearing of timbered lands invites an ever-increasing aridity of climate and diminishing fertility of soil."

Mr. A. W. Howitt gives a paper on the diorites and granites of Swifts' Creek, and their contact-zones, with notes on their auriferous deposits.

Rev. J. E. Tenison-Woods, F.L.S., describes the genus *Amathia* of Lamouroux, and in particular a new species, *A. tortuosa*, and introduces a history of the progress of our knowledge of the Polyzoa.

The Rev. R. H. Codrington, M.A., contributes a paper on the customs of Mota, Banks Islands, many of which are fantastic in the extreme. It is remarkable that, though no monkeys occur in the Fiji Islands, yet the native language has a word for monkey. Through all these islands traditions of wild men, living in trees, are current. The author considers that the natives are not so wanting in moral feeling as is represented by Sir J. Lubbock, upon the authority of Mariner.

The remaining papers which we notice are—"New Localities for Minerals in Victoria," by J. Cosmo Newbery; "Notes on the Geology of the West Tamar District," by Norman Naylor; and

"On the Yarra Dialect and the Languages of Australia in connection with those of Portuguese Africa," by Hyde Clarke. The last-mentioned author considers that Australia was at some former period under the influence of a white race.

The Geological Magazine, or Monthly Journal of Geology. Edited by H. WOODWARD, F.R.S. October, 1880.

THIS issue contains an interesting paper by Thorvaldr Thoroddsen, on the volcanic eruptions and earthquakes of Iceland—a subject still very imperfectly known. The author enumerates the volcanoes known to have been active in historical times. Those still active form two lines, the one including Hekla, running from S.W. to N.E., and the other from S. to N. From A.D. 900 to the present day eighteen eruptions of Hekla are on record, thirteen of Katla, and many whose exact sources cannot be ascertained. Those occurring along Skapta and Hverfisfljot, in 1783, are pronounced of a magnitude unparalleled on the earth in historical times. They proved fatal to 9000 human beings, 21,000 cattle, 36,000 horses, and 233,000 sheep. From 1784 to 1821 no eruption is on record.

According to Mr. W. Pengelly the former presence of the glutton in Britain was demonstrated by the late Mr. J. C. Bellamy in 1839.

Journal of the Scottish Meteorological Society. New Series. LX. to LXIII. Edinburgh and London: W. Blackwood and Sons.

THIS issue contains a paper on the diurnal period of thunderstorms in Scotland, from which it appears that there is a well-marked daily minimum and maximum, storms being least frequent from 6 to 10 a.m., and most frequent from 3 to 6 p.m. There are traces of a secondary maximum from 3 to 6 a.m. In Iceland thunderstorms are essentially winter phenomena, and nocturnal.

A notice of the Tay Bridge storm of December 28th, 1879, mentions the extraordinary barometrical fluctuations near the central track of the storm. The temperature rose also to 51°—57°, being the average for the first week of June.

Victoria: Report of the Chief Inspector of Mines to the Honourable the Minister of Mines, for the year 1879. Melbourne: Ferres.

THIS report is devoted to the statistics of mining accidents and the means for their prevention. One man appears to have been poisoned by the fumes of burning nitro-glycerine.

Victoria; Reports of the Mining Surveyors and Registrars. Quarter ending March 31, 1880. Melbourne: Ferres.

THE total amount of gold obtained during the quarter is 179,949 ozs. 12 dwts., of which 66,174 ozs. 1 dwt. is from alluvial deposits, and 113,775 ozs. 11 dwts. from quartz reefs.

Records of the Geological Survey of India. Vol. XIII., Part 3. 1880.

THIS part contains an account of the Kumann Lakes, by Mr. W. Theobald, who maintains their glacial origin in opposition to Mr. Ball.

The same author communicates a notice of a celt of palæolithic type which he found near Shodipur, on the Indus. Kishen Singh, of the Geological Survey, had previously found a similar article near Rhotas, in the Punjab, but had thrown it away in ignorance of its nature.

Dr. Feistmantel furnishes palæontological notes from the coalfields of Karharbari and South Rewah, and also notes on the correlation of the Gondwána flora with other floras.

Mr. W. King gives a note on the artesian wells of Pondicherri.

Mr. Hacket discusses the occurrence of salt in the soils and waters of Rajputana.

There are also some notices of an eruption of gas and mud on the coast of Arakan in 1843, and again in 1879.

Memoirs of the Geological Survey of India. Palæontologia Indica. Ser. XIII. Salt-range Fossils. By W. WAAGEN. Ph.D. Calcutta: Geological Survey Office. London: Trübner and Co.

THIS issue is devoted to the Gasteropoda, with a Supplement relating to fishes and cephalopods.

Monthly Notices of the Royal Astronomical Society. Vol. XL., No. 9.

THIS number contains a paper on Babylonian Astronomy, by Mr. Bosanquet and Prof. Sayce; an additional note by the Astronomer Royal on the Theoretical Value of the Acceleration of the Moon's Mean Motion; a paper by Mr. Glaisher, on the Method of Least Squares; and a memoir on the Possible Performance of an Object-Glass for Star-Gazing, by Mr. Sang. There is also a note on the Nebula near *Merope*, by Prof. Tempel; observations on Comet I, 1880, made at the Cape of Good Hope, by Mr. Gill; a method of determining the pressure on the Solar Surface, by Prof. Wiedemann; a note on a Disappearance of Jupiter's Satellites in 1611, and on the August Perseids, by Admiral Sir E. Ommanney.

The Attraction of Simple Gravity. By the Rev. G. T. CARRUTHERS, Chaplain of Chakrata, India.

THE author of this essay undertakes to show that Newton's theory of attraction is true merely as a result of a constant force in the line of motion. If his explanation is satisfactory, Newton's Law is removed from its eminence as a law of Nature, and occupies the ground of a convenient apparent law only. He considers that the true law of Nature is that of a force varying directly as the distance. "In the evaporation and condensation of water, which I assume to be the only motive force, we have two centres of force, one attracting and the other repelling with the same intensity, and so producing an apparent constant force." For the author's demonstration of these views we must refer our readers to his pamphlet.

---

*The Lepidoptera of the Tauferer Valley.** By Prof. JOSEF WEILER. Insbruck: Wagner.

LIKE the determination of constants in chemistry and physics, the establishment of local faunæ is a tedious task, which, though of very high value to Science, is far from meeting with the recognition which it deserves. It seems to us that systematic

* Die Schmetterlinge des Tauferer Thales. Ein Beitrag zur Lepidopteren Kunde von Tirol.

observations of this kind are particularly needed along the great mountain chain which separates Central from Southern Europe as being calculated to show the respective adaptability of their northern and southern slopes to the life of different groups and the influence of the Pyrenees, Alps, Carpathians, &c., in obstructing or diverting the migrations of species. It is also calculated to throw light upon another point often overlooked as a condition of animal life—the influence of altitude. Swiss and South German naturalists recognise here six distinct regions: the plains and lower eminences up to 1800 feet (569 metres) above sea-level; the mountain dales with the lower forest-region up to about 1400 metres; the upper forest zone reaching to 1740 metres; the lower Alpine region up to 2000 metres; the lower Alpine to 2500 metres; and finally the snow-region including the mountain-summits.

The Tauferer valley does not extend down into the first region, and in consequence certain genera—such as *Apatura*—are absent, whilst others—such as *Papilio*, *Limenitis*, and *Satyrus*—are but slightly represented. The number of species and varieties actually captured or identified by the author and his friends amounts to—Rhopalocera, 134; Sphingidæ, 29; Bombycidæ, 80; Noctuidæ and Geometridæ, 166 each, making a total of 575 Micro-Lepidoptera. If from the 134 butterflies we deduct the 25 considered as mere varieties, there remain 109 true species. This is the more remarkable if we consider that many trees and shrubs upon which caterpillars feed are wanting, such as the oak, the beech, the snow-ball tree, the lilac, and the spindle-tree. The geological character of the district varies little, so that the great valley and its lateral dales afford no opportunity of studying the influence of such features upon the local occurrence of species. Still every dale has some peculiar feature in the forms which it presents. During the last thirty years the author has observed not a few changes in the Lepidopterous fauna of the district,—some of them referrible to the destruction of the forests and the recession of the glaciers. It does not appear to have formed any part of the author's plan to note whether specimens of any species found in this district vary in a uniform manner, whether in size and colouration, from their fellows in other Alpine valleys, or in the low grounds of Germany or Italy.

We must pronounce this pamphlet a useful contribution to entomology, and we wish that some of that unhappy class of collectors who waste their days in amassing so-called "British" species, and who give from £8 to £40 for a specimen merely because it has been caught in the United Kingdom, would spend their leisure in a similar manner to Prof. Weiler.

Natural Philosophy for General Readers and Young Persons. Translated and Edited from Ganot's "Cours Elementaire de Physique." By E. ATKINSON, Ph. D., F.C.S. Fourth Edition. London: Longmans and Co.

A MANUAL of physics like the present, free from mathematical formulæ and altogether couched in intelligible language, should command a wide circle of readers, and we are not surprised that the publishers have found it necessary to issue a fourth edition. The work contains not merely a clear, though necessarily concise, statement of the laws of optics, acoustics, heat, magnetism, electricity, &c., but it gives a description of many of the most popular applications of these sciences, the electric telegraph, the electric light, the telephone, &c.

We notice with some surprise, however, that in the chapter on light there is no mention of polarised light and its applications in physico-chemical research and in microscopy. Fluorescence also is omitted, and phosphorescence is briefly dealt with. The author remarks that this property is "very intense in the glow-worm and the lampyre." Glow-worm is the ordinary English name of the Lampyris. The figure of a compound microscope given is one of the old immovable upright type, the very sight of which makes our neck ache.

The paragraph on the liquefaction of gases can scarcely be considered on a level with the present state of science. Thus we read: "Few gases can resist these combined actions (cold and pressure), and probably those which have not yet been liquefied, hydrogen, oxygen, nitrogen, binoxide of nitrogen, and carbonic oxide, would become so if submitted to a sufficient degree of cold and pressure." These lines were of course written before the successful experiments of MM. Cailletet and Pictet, and have not been modified in accordance with the capital discovery effected by these eminent physicists.

We submit that in a work of such indisputable value as the one before us, these oversights should not have been suffered to remain.

Contributions to the Chemistry of Bast-Fibres. By E. J. BEVAN and C. F. CROSS. Manchester: Palmer and Howe.

IN this memoir, which was read before the Owens College Chemical Society, April 16, 1880, the authors give the result of two year's work in a field of research which has hitherto been little cultivated. They take jute as the type of the class. The main portion of the intercellular tissue is, they consider, a cellulo-quinone. These investigations, which are still in progress, will doubtless throw new light on the principles of bleaching and dyeing.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

LIFE AND MIND ON THE BASIS OF MODERN MEDICINE.

To the Editor of the Journal of Science.

SIR,—I have read with interest your criticisms of Dr. Lewins's "Life and Mind," and of my Appendix to that remarkable treatise. Will you allow me a small portion of your space in which I may answer, first, your allusion to Dr. Lewins's not venturing "to deny the possible existence of an Eternal Mind," or attempting "to show how physical energy is transformed into life;" and, secondly, your impeachment of my estimate of the character of those lives which are wholly devoted to scientific pursuits—"that is, to specialism."

A perusal of "Life and Mind" will show why its author refuses to dogmatise, or even to speculate, respecting the existence of a Supreme Intelligence. Such an abstention is the only possible logical result of the relativity of human knowledge which finds expression in Dr. Lewins's theorem that "higher than himself no man can think, his own perceptions and conceptions constituting his entire universe." If this position be self-evident it surely follows that either to affirm or to deny the existence of a something which utterly transcends man's perceptions and conceptions would be an act of gross inconsistency—altogether inconsonant with the first principles of his Thesis, as of Inductive Science itself. Any attempt to explain the transference of physical energy into life is now, ever has been, and probably ever will be, a purely eschatological abuse of reason—a Will-o'-the-Wisp pursuit of a phantom, which, as wholly beyond the range of our faculties, cannot be regarded as a rational theme for "explanation." There is as great a mystery underlying the different perfumes of the rose and the violet as that which veils the origin of life. Why these odours are different to our perception we do not know, and we are not called upon to explain. I may confidently state that the opinions I have expressed in my

Appendix, with regard to our duty of ignoring all things transcendental, are those of Dr. Lewins himself.

I will not encroach much further upon your space, except to say that, granting our postulate that healthy sensation is the chief end of Life, my allusion to modern specialists stand in no need of palliation. I submit that there have been, and are, men "who make discovery their ruling passion," and that to this Moloch "they sacrifice the harmony, equilibrium, and happiness of their lives." (*Vide* "Life and Mind," App., 59). The allusion to Faraday seems perfectly justified, since it furnishes an apt illustration of the evils resulting from the unnatural and uncalled-for protraction into old age of *intense* contemplative pursuits and analysis. I do not deny the value of scientific education, but I maintain that such should be confined to the formative (*Werdende*) period of human life. The "complete man" is he who preserves healthy sensation, whose cerebral functions have been duly trained, not over-trained, so as to become asymmetrical by excessive scientific discipline. In such a man we see, as Dr. Lewins expresses it, all that poets have fabled of the golden age, or that religious founders have denominated the kingdom of heaven. On the other hand, we know that outside his own speciality of formal Physics even such a prodigy as Newton was below, rather than above, the standard of the *Vir*—the all-round man, "*totus teres atque rotundus.*" Why, I would ask, does no very successful professional man desire for his son, or others dear to him, his own career?* If Science really were the supreme vocation its zealots represent it to be, how comes it we have not successive generations of scientists as we have of soldiers and sailors? In thus writing I know I express the experience of the author of "Life and Mind," who holds that in particular medicine presents no future for men of idea-ed minds, and that its routine drudgery only suits those among its followers who spring from the less cultured classes of the community. Its high rate of mortality alone proves its incompatibility with the conditions of natural life. If such be the case in the science of human nature, which medicine truly is, we can readily understand why, in modern Europe, scientists (*Fach-manner*) do not follow, in such matters, the obligatory, hereditary caste, or family system, as it obtained among the ancient Egyptians.—I am, &c.,

THE EDITOR OF "LIFE AND MIND."

* For in much wisdom is much grief; and he that increaseth knowledge increaseth sorrow.—*Ecclesiastes* i., 18.

A QUESTION OF CONSISTENCY.

To the Editor of the Journal of Science.

SIR,—In your January number for the present year I find an article on the "Materialistic Origin of the Sexes," by Mr. Andrew Dewar, who is described as the author of the "Origin of Creation." Turning to your notice of that work (1875, p. 353) I find that the author desires to be judged "by the light of their (the readers') faculty of common sense and their own personal observation, without reference to any book whatever, except it may be the Scriptures." Is it not somewhat strange to find a writer who accepts the Scriptures as a scientific authority coming forward to clear difficulties out of the way of Materialism?—I am, &c.,

AN OLD SUBSCRIBER.

"NATIONAL SCIENTIFIC APPOINTMENTS."

To the Editor of the Journal of Science.

SIR,—Having for the first time in my life met with a file of the "Journal of Science" among a number of valuable and thoughtful articles, I have been particularly struck with the paper in your number for November, 1879 (p. 723), bearing the title which I have quoted. You will perhaps not deem it an impertinence if I give a guess at the motives of the authorities in their most unfair and absurd arrangement of offering, in an examination for the post of assistant in the Natural History department in a museum, 500 marks for elementary mathematics, 1000 for advanced mathematics, 500 for theoretical mechanics, &c., whilst zoology, botany, and physiology count for but 500 each. I believe it is to give an unfair advantage to the candidates who have studied at the public schools and at the old universities, and who, if the examination were confined to biology, as it ought to be, would be simply nowhere. In an examination arranged in the manner you state a zoological specialist must be so handicapped that his success would be a miracle.—I am, &c.,

FAIR PLAY.

INDUSTRIAL TRAINING.

To the Editor of The Journal of Science.

SIR,—The writer of the admirable article on "Industrial Training," in your January number, is evidently unacquainted with the peculiarities of the trade with which I am connected—the boot and shoe trade, as carried on by hand without the aid of machinery. The boys who go to this trade are generally sons of poor men who are unable to pay any premium at all, and therefore the boys are bound for six or seven years, chiefly with a view of compensating the master, as very few boys are worth much the first year or two. Every practical shoemaker would laugh at the idea of taking a boy for three months, or even twelve months, to learn his trade; but I should say that any boy who could learn the trade at all could certainly learn it in three years, and very few indeed in *less* time than that. And this brings me to what I have for years considered the greatest difficulty connected with this subject, and which the writer of the article in question but barely alludes to—the capacities of the boy for the trade he is about to learn. I have not the least hesitation in saying, and I speak with the authority of knowledge, that not one boy in ten of those who have been put to my trade have become good craftsmen. After trying for seven or more years, spoiling a great deal of leather, exhausting the patience of a number of instructors, and disappointing parents and master, they might in a short time become clever gardeners, engine-drivers, painters, lecturers, or even preachers, but *never could learn to make a shoe*. A large proportion of those who have been put to this trade forsake it in disgust when "out of their time," and therefore I think the great desideratum is a method of ascertaining the boy's capabilities for the trade before he is finally "bound to it."

I know not whether the same difficulty applies to other trades, but, if so, what is the remedy? Probably the writer of the article in your excellent journal may be able to suggest one.

Would it be practicable to institute preparatory industrial schools or colleges, or to connect departments of that kind with some of the present schools?

If you think this letter worth publishing you are at liberty to do so, or to submit it to the writer of the article in question.—I am, &c.,

JOHN BELL.

CHEMISM AND THE SEXES.

To the Editor of the Journal of Science.

SIR,—If the duality of properties found in the elements is to be taken as a simple expression for sex, we ought at least to find such duality absolute. The behaviour of such a body as oxygen introduces a factor certainly not represented in sexual phenomena, and I think upsets the analogy drawn by Mr. Dewar in your January number. When Berzelius, applying his electrochemical theory to the explanation duality, divided the elements into + and − groups, he himself, though imbued with the spirit of Lavoisier, recognised that the distinction was a *relative*, not an absolute one.

Mr. Dewar says "No natural production can be found containing the elements of only one class," and that "combination cannot be produced among the elements of one class only." Surely he must be acquainted with carbon dioxide, and with the formation of, say, sodium amalgam (which is attended, by-the-bye, with the production of that "old element" flame). Apparently, however, your contributor did not trouble himself about elementary facts while evolving his theory, for he describes air as a dual *combination* of oxygen, nitrogen, and *hydrogen!* Mr. Dewar argues for the death of Materialism with the failure of his hypothesis, but it is an elementary chemical fact that compounds may have properties totally different from those of their elements,—therefore to prove that matter contains within itself the "potency of life" one need not seek in the elements the properties of a definite compound, viz., Protoplasm.—I am, &c.,

F. G. H.

SIMULATION OF ANIMALS TO PLANTS.

To the Editor of the Journal of Science.

SIR,—In "Tropical Nature" Mr. Wallace remarks on the simulation which naturalists on the Amazon observed in the insect tribes. Sir F. B. Head, in his "Journey across the Pampas," says he "constantly observed the singular manner in which all animals, particularly birds, are protected from their enemies by plants and foliage which resemble them." In his journey across

the great Cordillera he saw "large tawny-coloured fungoid-looking substances which in size, shape, and colour resembled lions (pumas) lying on the ground." So great was the likeness, he says he "could not distinguish whether they were (pumas) or not" (p. 77). Speaking of the parrots, he says, "The plumage of the breasts is always of the most gorgeous and brilliant description, but their backs are invariably of the colour of the country they inhabit. In the region of woods it is generally green and bright yellow—they are of these hues; in the plains of grass their backs are a mixture of brown and green, and they so resemble the surface of the country as they skim over it that it is as difficult to trace them as it is the partridge when flying over ploughed lands" (p. 126). These facts appear to support Mr. Wallace's theory of colour in birds as contra-distinguished from that of Mr. Darwin.—I am, &c.,

S. B.

NOTES.

The Threatened Epidemic of Small-pox.—London is apparently once again threatened with an epidemic of small-pox: the disease is described as marching on the metropolis from the south-east, and as being sporadically present in the south-west, and districts apparently unconnected with each other. It has been the custom for some years back to attribute the origin of small-pox, as of other *zymotic* diseases, to such causes as filth, *fermentation*, specific poison, and so on, its propagation to contagion. We should be glad to have the views regarding the present outbreak of those who would thus account for the large class of diseases of which small-pox is one. As a matter of fact, the recurrence of small-pox, typhus fever, and some other diseases, takes place at regular intervals of time, and, as far as we are able to see, without any difference in conditions as regards filth, or rather cleanliness of places, on such occasions from what prevails during its absence. Communication between persons is no greater during its presence than while small-pox is absent: if, therefore, the extension of an epidemic depends upon contagion alone, how are we to account for its cessation after having prevailed in a locality for a certain defined time? These and kindred questions bearing upon epidemiology are perhaps easier put than answered.—*Medical Press and Circular.*

According to Dr. Berkhan ("Zeit. für Psychol.") marriages between normal men and cretin women are sometimes prolific, but the children usually die during childhood.

M. Cœurdevache (singular name!), of the meteorological observatory in the Park of Saint Maur, finds, from a series of special observations, that the lowest mean diurnal temperature in the months of March, April, and May, occurs about the 20th and 21st day of the moon.

A writer in the "Times" complains in bitter terms of the cost of the Geological Survey of the United Kingdom. The "Geological Magazine" points out in reply that, considering the difficult nature of their duties, the men employed are not overpaid. One of them, after working for twenty years, receives £180 yearly, and another, who has served over thirty years, receives £219!

According to the "Scottish Naturalist" a hoopoe was seen in Unst in October last, and paid the usual penalty for appearing on British ground. Its stomach was found filled with earwigs,

—a fact which furnishes a powerful argument for the preservation of this harmless and beautiful bird.

"The Victorian Year-Book for 1879-80" gives a curious ethnological fact. Of every 1000 native-born Victorians the proportion of criminals is 11·18; of natives of England and Wales, 40·23; of Scotland, 39·91; of Ireland, 80·36; and of China only 12·64! Hence an Englishman or Scotchman is more than three times, and an Irishman more than six times, as likely to commit crime as the much-denounced Chinaman.

According to M. E. Allary ("Bulletin de la Soc. Chimique de Paris") the proportion of iodine in sea-weeds ranges from 1·224 kilos. per 1000 in the fresh leaf of *Digitatus stenolobus* to 0·007 kilo. in *D. bulbosus*.

According to the "Dundee Advertiser" certain bees in New South Wales having suffered from drought, made provision for such an emergency by storing a large number of cells in every hive with water. Pending the confirmation of this singular anecdote we reserve comments.

Prof. Lister, F.R.S., in an Address delivered before the British Medical Association on "Micro-Organisms and their Relation to Disease," observed very justly that if the researches of MM. Pasteur and Toussaint should lead to nothing more than what seems to be already on the point of attainment,—the means of securing poultry from death by "chicken-cholera" and cattle from the terribly destructive splenic fever,—it must be admitted that we have an instance of a most valuable result from much-reviled vivisection.

We are happy to learn that a Civil List pension of £200 annually has been conferred upon Mr. A. R. Wallace, in recognition of his splendid services to biological science.

Mr. J. C. Branner communicates to "Science" some observations on the habits of the Brazilian "Cambota" (*Callichthys asper*). He watched one of these fishes travel a distance of 90 metres on dry ground.

According to the "Medical Press and Circular" a woman at Ipswich, of the name of Lockwood, has not taken more than a pound of solid food during the year 1880. Since September she has partaken of nothing but a few drops of weak tea. She is sometimes in a state of coma for days together.

The same journal announces that another of the London hospitals is in danger of entering upon a career of rampant "nursedom."

It is somewhat significant that in the poem in which the Laureate has recently libelled the medical profession he contrasts an angelic nurse with the coarse, unfeeling doctor.

According to Biedermann's "Central-Blatt" the fat of animals in a natural condition is richer in solid fatty bodies than that of such as have been artificially fattened, and is therefore preferable for use in manufactures.

Mr. F. M. Webster, of the Illinois State Laboratory of Natural History, is engaged with some interesting researches on the food of beetles, considered from an economical point of view. He finds that many of the Geodephaga are less exclusively carnivorous than has been taken for granted, and are even occasionally injurious by destroying seeds, the stems of plants, &c. He confirms the Aphis-eating character of the Telephoridæ.

The Council of the Entomological Society of London has formally petitioned against the proposed railway from Chingford to High Beech, as calculated to lay waste a part of Epping Forest very interesting to naturalists.

According to Dr. E. C. Spitzka ("Science" and "St. Louis Clinical Record"), in "Schenck's Lehrbuch der vergleichenden Embryologie der Wirbelthiere," p. 137, is figured a section taken flatwise through the embryonic human paw. The chondrogenic elements of the mesoblast can be seen arranged in strands, indicating the metacarpo-phalangeal rays. A *sixth* ray seems very clearly present. At different periods these cell-strands are not five, but from seven to nine in number. This fact points to the descent of man and the pentadactylous animals from the Enaliosaurians or analogous groups of the Jurassic and Triassic Epochs, whose remains show seven or more fin-rays. Hensen, of Kiel, found in the human embryo of the seventh week the fingers and toes provided with claws like those of the Carnivora, which are exfoliated to make way for true nails. He found also plantar and palmar eminences, like the foot-pads of the dog, cat, and carnivorous marsupials.

The "American Naturalist" declares "the cultivators of natural history imbibe their early love for Nature during their out-of-door early life in the country. Nearly all our leading naturalists were country-bred boys."

H. Michels has investigated, with great care and exactness, the changes of the nervous system of Coleoptera during their metamorphosis.

The Emperor of Germany has defrayed the expense of the excavations at Olympia out of his private purse.

An article in the "Kansas City Review of Science," criticising the philosophy of Mr. Herbert Spencer, contends that there is beneath the laws and forms of nature an Agency to which design and purpose can scarcely be denied.

Sagacity in Animals.—Mr. Haygrath ("Bush-Life in Australia") says "We had a half-tamed native dog, 'dingo' or 'warragee,'" chained in a small enclosure into which a merino ram accidentally strayed. Not seeing his way out he "prepared to attack his natural enemy." The dog "stood out as far as his chain would admit" and awaited the onset. The ram "retreated backwards to some distance, and rushed on his foe . . . with an impetus which would have felled an ox." When the blow "seemed inevitable," the dog suddenly crouched down and "seized his antagonist firmly by the throat as he flew over." The ram would have been killed but for our interposition (p. 116). Speaking of the "dingo" in his simulation of death, he says—"Its most striking peculiarity is its tenacity of life." "As a last resource it has a remarkable trick of shamming dead, . . . when it may be dragged by the heels and well-belaboured without flinching—lolling its head listlessly down as if quite lifeless, until a fair opportunity of crawling away presents itself" (*ibid.*). Speaking of the half-wild oxen, he instances the remarkable instinct they possess of locality. He says—"They have been known 'to make back' through every obstacle for hundreds of miles; and animals that have escaped from the very slaughter-house in Sydney have been found again, within a short time, on their former feeding-grounds at a vast distance in the interior." That sometimes settlers, when changing their stations, send their cattle by a circuitous route, "by way of mystifying their troublesome organ of locality;" but it has been found, "both by tracks and by sight, that the stragglers . . . have returned by the direct line through a country of which they had not the slightest knowledge." Another time he was expecting supplies, when "the pack bullock, with his load on his back, arrived without any driver." In anxiety as to his fate he followed the animal's track, which "had never been once at fault, or even stopped to feed." Sixty miles from the station he "found the driver alive and well, but in great tribulation for the loss of his charge, and was satisfied when told "that the animal, more sagacious than himself, had reached his journey's end safely" (*ibid.*, p. 57)

Our ably-conducted contemporary, "Science," gives abstracts of papers—by O. C. Marsh, on the Limbs of *Sauranodon;* by E. S. Morse, on the Identity of the Ascending Process of the Astragalus in Birds with the Intermedium; by H. C. Chapman, on the Placenta and Generative Apparatus of the Elephant, and, by the same author, on the Structure of the Orang-Outang.

According to Prof. Elias Loomis the centre of a cyclone has never been found within 6° of the Equator.

We learn that the Medical Officer of Health at Govan Hills receives a salary of £12 yearly, in consideration of which he is to give medical opinions when required, to make examinations, submit reports, and attend court if needful!

A writer in the "Journal of the Society of Arts" complains that "the ordinary run of tenants do not care and will not pay for properly constructed houses." True, because they have already to pay to the full extent of their means, and perhaps beyond, for improperly constructed ones!

Dr. J. H. Gilbert, F.R.S., doubts, on very substantial grounds, the alleged superior value of bread made from the entire wheat.

Prof. Broadhead, in a paper on the distribution of the Mastodon, communicated to the "Kansas City Review of Science and Industry," refers to traditions proving that this animal must have coexisted with the Red Indians.

On the Grains of Silica and Micrococci of the Atmosphere. By Dr. T. L. PHIPSON, F.C.S., &c.—At the period of the great debate on spontaneous generation between M. Pasteur and Pouchet, the latter was the first to draw attention to the fact that some of the minute spherical granulations discovered by the microscope in dust deposited from the air in various regions of the globe were essentially composed of silica. That they had often been mistaken for eggs of Infusoria or for Micrococci was very evident, but when the dust was submitted to complete calcination in a platinum crucible the same grains were still visible, with the same forms and dimensions as before. I have more than once repeated this experiment of Pouchet's, but I have also made the opposite one, and examined the action of heat upon Micrococci, diatoms, and Oscillariæ, which are supposed to contain large quantities of silica. There is no doubt but that the dust of the atmosphere reveals to the microscope, besides the larger mineral fragments mostly of an angular shape, exceedingly minute circular and spherical bodies, having often not more than 0·001 of a millimetre in diameter, and very similar in size and shape, which resist the action of a white heat in contact with the air and that of strong hydrochloric acid. In some of my observations they were remarkably numerous. Both before and after the action of heat they are more or less transparent. What can be the origin of these singular objects? The same experiments repeated with siliceous Algæ, such as those belonging to the large family of the Diatomaceæ and with the Micrococci of impure waters or vegetable infusions, showed me that they do not retain their forms after being subjected to the above treatment, and that in many instances they can be totally destroyed by heat on the object-glass itself. On the other hand, the fossil diatoms resisted the action of heat, and retained their forms. I can only draw one conclusion from these observations, namely, that the minute siliceous bodies found in the atmosphere are also fossil; they are Micrococci of another age.—*Chemical News.*

According to MM. Kühne and Steiner ("Untersuchungen aus dem Physiolog. Institut zu Heidelberg," iii., p. 327) the electric

fluctuations produced by light in a retina provided with the "visual purple" are different, both quantitatively and qualitatively, from those where the purple is absent.

According to H. Hoffmann ("Naturforscher," xiv., No. 3) the damage done to trees by frost is greater in the valleys than on hills, and greater in southern than northern exposures. There is not a fixed degree of cold necessarily fatal to trees of a certain species, but the injurious effect depends on the extent of the variation when a thaw occurs. A cold of −17 followed by a sudden rise to +3 is not more hurtful than a cold −10 abruptly changing to +10. For every species the amount of this amplitude is peculiar and fixed. The destruction of vegetation in warm aspects after a severe frost is noticed by Gilbert White ("Selborne," Letter LXI.).

According to J. Reinke ("Botanische Zeitung," 1880, No. 48) protoplasm contains, as its immediate constituents, plastine, viteline, myosine, peptone, peptonoid, pepsine, nucleine (?), lecithine, guanine, sarcine, xantine, ammonium carbonate, paracholesterine, traces of cholesterine, ethalium resin, a yellow colouring-matter, glycogen, a non-reductive sugar, oleic, stearic, palmitic, butyric acid (traces), carbonic acid, glycerides and paracholesterides of the fatty acids, calcium stearate, palmitate, oleate, lactate, oxalate, acetate, formiate, phosphate, carbonate, sulphate, a magnesium salt (probably a phosphate), potassium phosphate, sodium chloride, iron (in an unknown state), and water! The author obtained his material from the fruits of *Ethalium septicum*. He finds that protoplasm contains scarcely 30 per cent of albuminoids, and cautions the reader that this substance can no longer be spoken of as a coagulum of white of egg. Chemically speaking the protoplasm even of the lowest organisms possesses a very complex structure.

"Science" comments somewhat unfavourably on a lecture, illustrated with experiments, delivered by Dr. Beard before the New York Academy of Sciences, on "Mesmeric Trance."

Among the lectures to be delivered at the London College of Surgeons we notice a course on the "Structure of the Skeleton in the Sauropsidæ," by Prof. Parker; and a course, by Prof. Flower, on the "Anatomy, Physiology, and Zoology of the Cetacea."

Dr. S. V. Clevenger, in an interesting paper in "Science," suggests—basing his views upon the observations of Dr. Drysdale and the Rev. W. H. Dallinger, on the Amœba—that the sexual appetite is in its origin a transformation of hunger.

According to the Detroit "Lancet" the Boston physicians have adopted, as a part of their future code, the following:—A physician should not append his name, or permit it to be appended, to certificates in laudation of speculative health resorts,

health excursions, nutritive or dietetic preparations, proprietary formulæ, wines, mineral waters, beverages of real or supposed medicinal efficacy, or other hygienic materials."

M. A. Sabatier ("Comptes Rendus," xcii., p. 200) has made some interesting observations on the formation of the blastoderm in the Araneida. Their eggs present a type intermediate between those of the Crustacea (*Peneus*) with a general superficial segmentation and such with a regular discoidal segmentation, like those of certain fishes. The affinity of the Araneida with the other groups of Arachnida and with the insects is very distinct.

According to a paper read by M. Pasteur, before the Academy of Sciences, the saliva of a child, dead of well-pronounced hydrophobia, when introduced beneath the skin of rabbits, proved fatal in thirty-six hours. The symptoms, however, were quite distinct from those of rabies. In every case the blood of the deceased animals contained microscopic organisms of the form of a short rod, a little constricted about the middle. Each was apparently surrounded by an aureola of a mucous substance. Guinea-pigs resist the new disease, but dogs perish with symptoms quite distinct from those of any type of rabies.

According to Miss S. P. Monks ("American Naturalist") the larvæ of the dragonfly (*Æschna*) use their power of ejecting a stream of water from the branchial apparatus at the hinder end of the body as a means of defence.

Mr. E. B. Wilson places the Pycnogonida intermediate between the Crustacea and the Arachnida.

In the same journal is an account of some important experiments on the action of Pyrethrum powder upon cabbage caterpillars, potato-beetles, aphides, mosquitoes, and other noxious insects. The results were satisfactory except in the case of *Coreus tristis*, a bug which infests vegetable marrows.

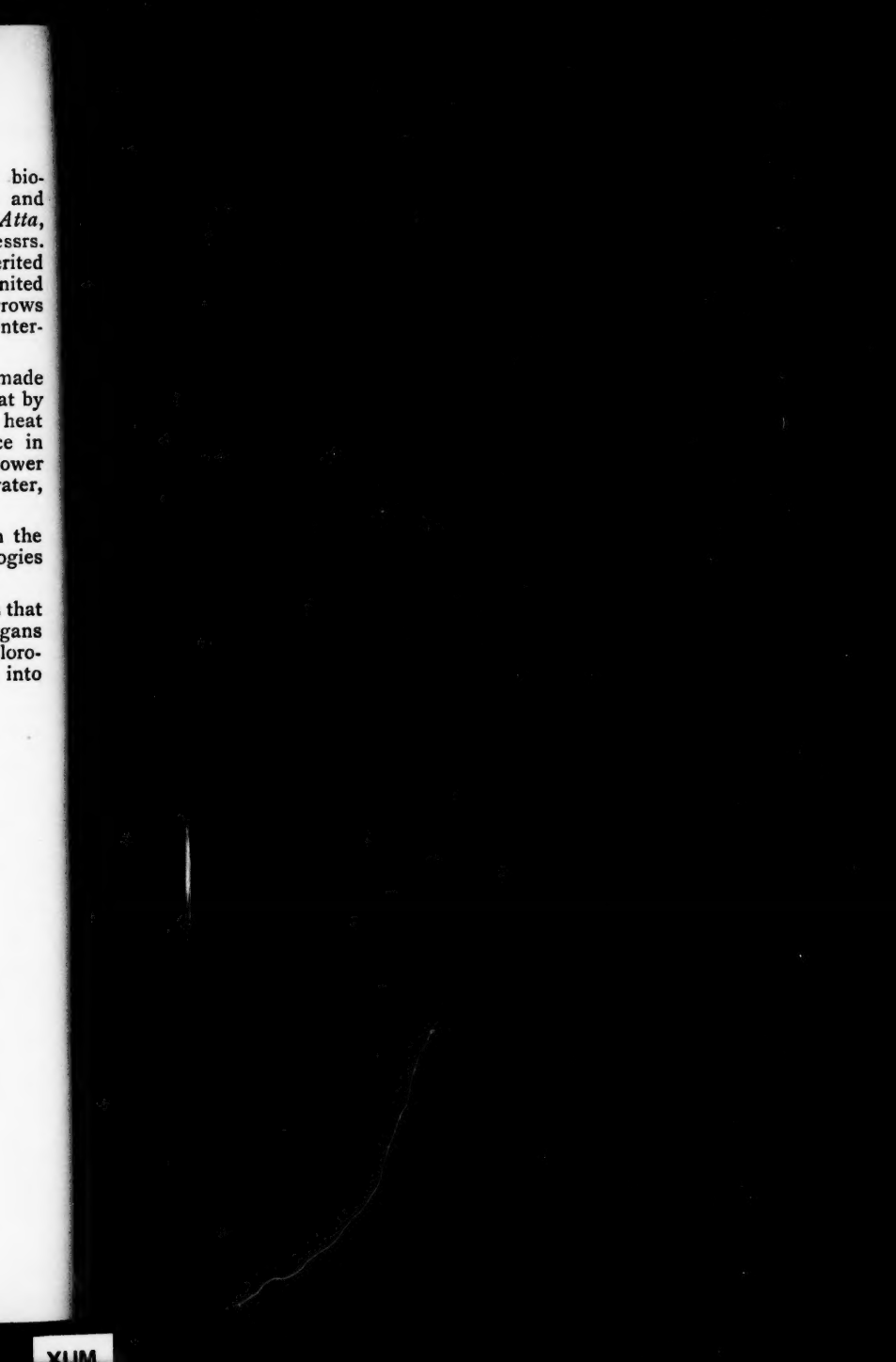
Baron von Reitzenstein (Psyche) describes an aquatic lepidopterous larva belonging to the family of the Sphingidæ (genus *Philampelus*). It feeds on water-plants and swims well.

According to the Report of the Mining Registrars of Victoria, for the quarter ending September 30, 1880, the total quantity of gold obtained has been 222,014 ozs. 16 dwts. The bullion exported was 58,080 ozs. 19 dwts., besides specie to the amount of £1,117,286.

Mr. Lester F. Ward contributes to the "American Naturalist" a most interesting paper, on "Incomplete Adaptation as illustrated by the History of Sex in Plants." He argues that adaptation is never absolutely complete.

In the same journal Miss S. P. Monks gives a valuable biography of the American green lizard (*Anolis principalis*), and Mr. G. K. Morris an account of a new leaf-cutting ant, an *Atta*, which inhabits the coast of New Jersey. The editors, Messrs. A. S. Packard, jun., and E. D. Cope, denounce, with well-merited indignation, the import-duty of 10 per cent levied in the United States on specimens in natural history. The English sparrows introduced into America have been found to construct winter-shelters quite different from their breeding nests.

M. Maquenne ("Annales Agronomiques," vi., 321) has made a series of researches on the absorption and radiation of heat by leaves. He concludes that all leaves dissipate a part of the heat which they receive vertically. This dissipation takes place in general more from the upper than the under side. Their power of absorbing heat is due to the presence of chlorophyll and water, and is greater in thick leaves than in thin ones.

Prof. F. Schultze has produced an interesting work on the development of speech in children, in which he traces analogies to the rise of speech in the human species.

Dr. Schimper ("Botanische Zeitung," 1880, No. 52) finds that even in the non-chlorophyllaceous cells of plants there are organs which produce starch. These organs are undeveloped chlorophyll granules which are capable of being converted into chlorophyll under the influence of light.